

MICHIGAN GEOLOGICAL AND BIOLOGICAL SURVEY

Publication 10.

Biological Series 3.

THE HERPETOLOGY OF MICHIGAN

BY

ALEXANDER G. RUTHVEN,
CRYSTAL THOMPSON AND HELEN THOMPSON

MEMORANDA TOWARDS A BIBLIOGRAPHY OF THE ARCHAEOLOGY OF MICHIGAN

BY

HARLAN I. SMITH

PREPARED UNDER THE DIRECTION OF
ALEXANDER G. RUTHVEN
CHIEF NATURALIST



ISSUED AS A PART OF THE ANNUAL REPORT OF THE BOARD OF
GEOLOGICAL SURVEY FOR 1911

LANSING, MICHIGAN
WYNKOOP HALLENBECK CRAWFORD CO., STATE PRINTERS
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BOARD OF GEOLOGICAL AND BIOLOGICAL SURVEY.

1912.

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LETTER OF TRANSMITTAL.

*To the Honorable the Board of Geological and Biological Survey
of the State of Michigan:*

Governor Chase S. Osborn, President.

Hon. D. M. Ferry, Jr. Vice President.

Hon. L. L. Wright, Secretary.

Gentlemen:—I beg to present herewith as a part of the report for 1911 of the Board of Geological and Biological Survey, Publication No. 10, being a contribution to the biological survey of the state authorized by Act No. 250 of the Session of 1905.

Very respectfully,

R. C. ALLEN,

Director.

Ann Arbor, Mich., October 1, 1911.

R. C. Allen, State Geologist, Lansing, Michigan:

Sir:—I transmit herewith a report upon the amphibians and reptiles of Michigan, prepared under my direction, to form a part of the series of monographs on Michigan forms that the biological division proposes to issue, and a bibliography of Michigan archæology compiled by Mr. Harlan I. Smith of the Victoria Memorial Museum. According to our plan for the series, the papers in this report attempt to summarize our present knowledge of the subjects treated and in such a way that the results may be used by teachers and local naturalists and archæologists.

Respectfully,

ALEXANDER G. RUTHVEN,

Chief Naturalist.

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THE HERPETOLOGY OF MICHIGAN.

GENERAL INTRODUCTION.

BY ALEXANDER G. RUTHVEN.

In view of the geographical situation of Michigan, it might be expected that its reptile and amphibian faunas would by this time be at least as well known as those of other states east of the Mississippi River. As it is our knowledge of the status of these groups in the state is astonishingly meager. It is true that all of the species known to occur in the state are well known to herpetologists, as they are, without exception, forms that occur commonly elsewhere in eastern North America, but of the actual number of forms that occur within our limits and the distribution, habits and variations of these we have as yet most inadequate data. Furthermore, there are practically no general works on the amphibians and reptiles of the state for the use of students and other persons interested in natural history.

Recognizing the need of a summary of the herpetology of Michigan the survey set aside out of the appropriation for 1907, \$250.00 for the preparation of a work on the reptiles of Michigan and out of the appropriation for 1911, \$200.00 for the preparation of a report on the amphibians of the state. The writer took personal charge of the reptile work, and with the appropriation engaged Miss Frances Dunbar, assistant in zoology in the University of Michigan, to assist him. The second appropriation was given to Miss Crystal Thompson and Miss Helen Thompson, who have had charge of the amphibian work under the direction of the writer.

In the pursuit of the work two ideas have been kept in mind: first, to make the results of genuine scientific value as a summary of our knowledge of the status of the groups in the state, and, second, to present the results in such form that they may be readily grasped by students and teachers and used as a reference work in the schools of the state. In order to place Michigan herpetology on a firm basis only those species are included (a) of which the writers have examined specimens¹ from authentic Michigan local-

¹ All specimens referred to in this report are in the University of Michigan Museum of Natural History unless otherwise stated.

ities, or (b) of which specimens have been examined by competent authorities, or (c) that have been reported to us by reliable observers who could unmistakably describe them. We have rigidly excluded all records by persons who possibly did not know the forms in question. It is believed, therefore, that the work is reliable as far as it goes, and, altho it is of course incomplete, for there are large areas in the state from which no or only a few records have been obtained, we trust that it will serve as a basis for future work and as an incentive to further investigation. It should be added that all descriptions of species are based on Michigan specimens unless otherwise stated.

January 1, 1912.

THE AMPHIBIANS OF MICHIGAN.

BY CRYSTAL THOMPSON AND HELEN THOMPSON.

INTRODUCTION.

One of the greatest difficulties encountered by the general student when he attempts the study of Michigan amphibians is the lack of a general work on the subject. Many papers have been published, but these are principally local lists and are so widely scattered that they are not generally available. The general books on the group are quite adequate for the determination of species, but they do not, as a rule, give the correct distribution of the forms in the state, so that, aside from the disadvantage of having to deal with many more forms in the keys than we have within our limits, the further objection to their use is that one can scarcely tell from them what species to expect in any region.

It is the purpose of this paper to present in a concise and convenient form the present knowledge of the amphibian fauna of Michigan. The work is necessarily far from complete because of the lack of data from many parts of the state, but it is hoped that it will prove of assistance to students. It should also serve to arouse an interest in this group of vertebrates that will result in the accumulation of data on the intrastate distribution of the species, particularly as an effort has been made to show just how much information is at hand for each section.

LITERATURE.

The published papers that deal either entirely with Michigan amphibians, or that include definite records for Michigan are as follows:

1. Sager, Abram. Report to the State Geologist. Senate Doc., State of Michigan, 1839, 294-305. Includes a catalogue of the amphibians of the state. The following species are listed: *Bufo musicus* (*americanus*), *Hyla versicolor*, *Rana clamitans*, *Rana halecina* (*pipiens*), *Rana palustris*, *Rana sylvatica*, *Rana gryllus* (*Acris gryllus*), *Salamandra symetrica* (*Diemictylus viridescens*),

Salamandra cinera (*Plethodon erythronotus*), *Menobranthes lateralis* (*Necturus maculosus*).

2. Holbrook, John Edwards. North American Herpetology, Vol. IV, 1842. Holbrook states, on the authority of Dr. Kirtland, that *Rana sylvatica* is common in the woods of Michigan.

3. Miles, M. A Catalogue of the Mammals, Birds, Reptiles and Molluses of Michigan. First Biennial Report of the Geological Survey of Michigan, 1861. This, as the name implies, is merely a catalogue of the species supposed to occur in Michigan. The list of amphibians includes: *Bufo americanus*, *Acris crepitans* (*gryllus*), *Hyla versicolor*, *Hyla pickeringii*, *Helocaetes triseriatus* (*Chorophilus nigrilus*), *Rana catesbeana*, *Rana fontinalis* (*clamitans*), *Rana pipiens*, *Rana palustris*, *Rana sylvatica*, *Ambystoma punctatum*, *Ambystoma luridum* (*tigrinum*), *Ambystoma laterale* (*jeffersonianum*), *Diemictylus viridescens*, *Plethodon cinereus*, *Necturus lateralis* (*maculosus*). There are a few footnote references to localities.

4. Milner, James W. Report on the Fisheries of the Great Lakes. Report of the U. S. Fish Commission, 1872-3. Milner reports *Necturus* from Grand Haven, Ecorse and the Detroit River.

5. Smith, W. H. The Tailed Amphibians, including the Caecilians; A Thesis presented to the Faculty of Michigan University, 1877. Descriptions are written of the specimens in the University of Michigan Museum. In no case is the specific locality given.

6. Smith, W. H. Catalogue of the Reptilia and Amphibia of Michigan. Supplement to Science News, 1879. Under Amphibia Smith lists: *Rana halecina* (*pipiens*), *Rana palustris*, *Rana temporaria* var. *sylvatica*, *Rana clamitans*, *Rana catesbyana*, *Bufo lentiginosus*, *Hyla versicolor*, *Hyla pickeringii*, *Chorophilus triseriatus*, *Acris gryllus* var. *crepitans*, *Plethodon erythronotus*, *Plethodon erythronotus* var. *cinereus*, *Notophthalmus viridescens* (*Diemictylus viridescens*), *Ambystoma punctatum*, *Ambystoma opacum*, *Ambystoma tigrinum*, *Ambystoma jeffersonianum* and *Menobranthes lateralis* (*Necturus maculosus*). The species known to occur at Ann Arbor are starred.

7. Smith, W. H. Report on the Amphibians and Reptiles of Ohio. Report of the Geological Survey of Ohio, Vol. IV, 1882. Mentions *Plethodon erythronotus*, *Ambystoma tigrinum* and *Ambystoma opacum* as coming from Ann Arbor.

8. Cope, E. D. Batrachia of North America. Bulletin 34, U. S. National Museum, 1889. Specimens of *Necturus maculosus*, *Ambystoma tigrinum*, *Plethodon cinereus*, *Plethodon glutinosus*,

Rana clamitans and *Rana palustris* are listed from Michigan.

9. Kirsch, Philip H. A Report on the Investigations in the Maumee River Basin during the summer of 1893. Bulletin U. S. Fish Commission, Vol. XIV, 1894. In the list of amphibians observed in the Maumee River Basin, *Rana sylvatica* and *Rana clamitans* are recorded from near Hudson, Mich.

10. Clark, H. L. Notes on the Batrachians and Reptiles of Eaton County. Fourth Ann. Report Michigan Academy of Science, 1902. This list includes the species found in Eaton County by the writer and those reported to him by reliable observers.

11. Ruthven, Alexander G. Notes on the Molluscs, Reptiles and Amphibians of Ontonagon County, Michigan. Sixth Ann. Report Michigan Academy of Science, 1904. Records the amphibians collected by the writer in Ontonagon County.

12. Ruthven, Alexander G. The Cold-Blooded Vertebrates of the Porcupine Mountains and Isle Royale, Michigan. Ann. Report of the Geological Survey of Michigan, 1905. The list of amphibians includes all of the data "available to the author on the occurrence of these animals in the Northern Peninsula."

13. Clark, H. L. A Preliminary List of the Amphibia and Reptilia of Michigan. Seventh Ann. Report Michigan Academy of Science, 1905. A list of amphibians whose presence in the state "is vouched for by at least one of the writers" (M. Gibbs, F. N. Notestein, H. L. Clark), together with the localities from which records were obtained. It includes in the bona fide list; *Necturus maculosus*, *Ambystoma maculatum* (*punctatum*), *Ambystoma tigrinum*, *Ambystoma jeffersonianum*, *Hemidactylium scutatum*, *Plethodon cinereus* and *P. cinereus erythronotus*, *Plethodon glutinosus*, *Diemictylus viridescens*, *Bufo lentiginosus americanus*, *Acris gryllus*, *Chorophilus nigratus triseriatus*, *Hyla versicolor*, *Hyla pickeringii*, *Rana pipiens*, *Rana clamitans*, *Rana palustris*, *Rana sylvatica* and *Rana sylvatica cantabrigensis*, *Rana septentrionalis* and *Rana catesbeana*. Unfortunately the sources of the individual records are not given.

14. Smith, Bertram G. The Breeding Habits of *Ambystoma punctatum* Linn. American Naturalist, Vol. XLI, 1907. Work on the breeding habits of *Ambystoma punctatum* was conducted at the University of Michigan and the material upon which the work was based was collected in the vicinity of Ann Arbor.

15. Hankinson, T. L. A Biological Survey of Walnut Lake, Michigan. Report Geological Survey of Michigan, 1908. A list of the amphibians found at Walnut Lake, Oakland County, during the spring and summer of 1906.

16. Ruthven, Alexander G. The Cold-Blooded Vertebrates of Isle Royale. Report Geological Survey of Michigan, 1909. A summary of the amphibian fauna of Isle Royale, based largely upon the results of the University of Michigan Museum expeditions to the island in 1904 and 1905.

17. Ruthven, Alexander G. Notes on Michigan Reptiles and Amphibians. Eleventh Ann. Report Michigan Academy of Science, 1909. This paper places on record some miscellaneous data upon the anophibians of Michigan. The writer refers the Michigan wood frogs to *Rana cantabrigensis* rather than *Rana sylvatica*.

18. Smith, Bertram G. The Nests and Larvae of *Necturus*. Biological Bulletin, Vol. XX, 1911. A larval specimen taken from the Detroit River, Nov. 24, 1906, is described.

METHODS OF STUDY.

The amphibians are a group of animals that will furnish many interesting problems to Michigan students. In the first place, while most observers of nature know something of their habits and considerable has been published on the subject, there is still much to be done upon the species to be found within our limits. Added to this is the fact that the species are not difficult to observe in the field after one becomes familiar with their haunts.

In taking up the systematic study of amphibians, it is desirable first to become familiar with the general characters of the group. The best method of doing this is to dissect a specimen, following the directions in some manual on the subject. The anatomy is treated in most vertebrate zoologies. The Frog Book, by Mary C. Dickerson, gives an excellent account of the characters used in the classification of the tailless forms, but unfortunately there is nothing at present available on the tailed amphibians. Other books which will prove helpful are, The Batrachians and Reptiles of the State of Indiana, by O. P. Hay, A Manual of the Vertebrate Animals of the Northern United States, by David Starr Jordan, and The Batrachia of North America, by E. D. Cope, although the latter is at present difficult to obtain and is for the most part technical and rather difficult for the beginner.

The external characters are sufficient for the identification of the Michigan species and are alone used in this work. The points to be considered in the identification are:—first, presence or absence of a tail in the adult state. This at once separates the two orders found in this region, the Salientia (tailless forms) and Caudata

¹ Since this bibliography was compiled two papers have been published, Thompson, 1911, and Ruthven, 1911a, containing records from Cass and Huron counties.

(tailed forms). In identifying the Salientia the following characters are used,—general external appearance, proportionate length of head and body, proportionate length of hind limb and body, presence or absence of parotid glands, presence or absence of lateral glandular folds, teeth, presence or absence of disks on fingers and

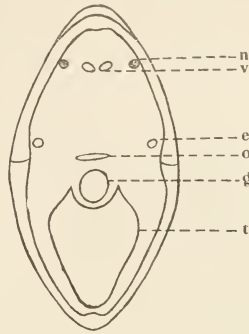


Fig. 1. Diagram of Mouth of Frog to Show Position of Teeth.

n, Internal nares; *v*, Vomerine teeth; *e*, Eustachian tubes; *o*, Oesophagus; *g*, Glottis; *t*, Tongue,

toes, ground color and pattern. The characters used in the identification of the Caudata are,—general external appearance, proportionate length of body and tail, shape of tail, number of costal grooves, number of toes on the hind feet, character and position of teeth (Fig. 2), ground color and pattern.

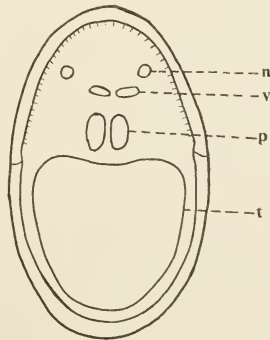


Fig. 2. Diagram of Mouth of Salamander to show Position of Teeth.

n, Internal nares; *v*, Vomerine teeth; *p*, Paresphenoid teeth; *t*, Tongue.

Teachers may outline laboratory and field work from the following suggestions. The collecting and identifying of species should precede or go along with the study of habits. The spring is the best time to observe the species in the field, for this is the breeding

season and the associated habits are most interesting. Particular points to be noted are,—time of appearance in the spring, habitat, food habits, time of breeding, characteristic notes of the different species, method of fertilizing the eggs, nature of egg masses, time of hatching of eggs, habits and metamorphosis of larvae.

METHODS OF COLLECTING AND PRESERVING SPECIMENS.

Collecting: Since most of the species come to the streams or ponds to breed in the spring this is the best season for collecting. They may also be collected during the entire summer and fall, but as most of the species leave the ponds after breeding and become more solitary, they are much more difficult to find. However, during the summer many frogs will be found along the borders of ponds and lakes, along the banks of streams, near springs, and in marshes, woods and fields. The toad and the tree frogs as a rule retreat from the water after the breeding season is past.

The Caudata, or tailed amphibians, with the exception of *Hemidactylium scutatum*, *Plethodon erythronotus* and *Necturus maculosus*, may be found in the spring in small ponds where they have gone to breed. At other times during the year they, with *Hemidactylium scutatum* and *Plethodon erythronotus*, are to be found under logs, moss, and in and around decaying stumps and logs in the woods. Some may also be found, before entering the water in the spring, under logs and stumps in woody places. *Necturus maculosus* may be caught at all seasons of the year in the larger lakes and streams. *Plethodon erythronotus* never enters the water. It may be found under the bark of decayed logs and similar places. *Hemidactylium scutatum*, so far as is known, does not enter the water. It may be collected, during the spring at least, under loose moss and in old stumps in low, wet woods. The two year old form of *Diemictylus viridescens* may be found in decaying logs with the other species, but younger and older forms occur in the ponds at all seasons.

Amphibians may be readily caught with the hands or by means of a net. The best net to use is a long handled dip net of small mesh and deep enough to prevent the escape of frogs after they are caught. The net is useful in collecting frogs or toads when in the water, or for scooping them out of the mud at the bottom of ponds. A 22 caliber rifle shooting cartridges loaded with dust shot (No. 14), or a 28 gauge shot gun loaded with light loads of powder

and dust shot, are very effective means of collecting large series of frogs.

The tailed amphibians are rather slow in their movements, and when on land they can be readily picked up by hand. When observed in the open water they may be easily caught in the dip net. Digging up with the net the leaves and mud from the bottom of ponds in woody places will usually result in the finding of several specimens.

Specimens may be carried from the field in a minnow pail in which there is enough water to keep them moist. When it is necessary to keep several collections separate, the animals may be placed in cheesecloth bags with some wet moss. Small specimens should be kept separate from the large ones so that the former may not be injured.

Keeping Live Material: It is often desirable to keep amphibians alive in the laboratory and the following suggestions may be found useful. Toads and frogs may be kept in large glass jars, covered over the top with netting and containing some moss and a small amount of water. Flies and earthworms placed in the jars will be eaten readily. The frogs should be sorted according to size and those of approximately the same size placed in the same jar, otherwise the large individuals will eat the smaller ones.

The small tailed amphibians which are terrestrial in habit, *Hemidactylium scutatum* and *Plethodon erythronotus*, may be kept in bacteria dishes with a little damp moss. If the moss is renewed frequently they will find sufficient numbers of insects and larvae in it to keep them in good condition. The Ambystomas and *Diemyctilus viridescens* should be kept in dishes containing moss, bark and dead leaves with some water at one side, so that they may enter it at will. They will eat insects, worms and small pieces of meat if offered to them. Small tadpoles placed in the water will furnish food for *Diemyctilus viridescens*.

The aquatic forms will need a larger supply of water. *Necturus* should be kept in a tank containing running water to the depth of two or three inches. There should be some floating plants or other objects under which they may partially conceal themselves. Raw beef cut in small pieces and presented on the end of a fine wire will sometimes be taken as food. If this method of feeding is not successful, small frogs and fish may be eaten if placed in the tank. *Necturus* will remain in good condition for a few weeks without food.

Preservation of Specimens: Amphibians which are to be per-

manently preserved should be properly killed and put up in a preserving fluid, for a poorly preserved specimen is usually worse than none. The best method of killing is to drown the animals. This can easily be done by placing them in small cheesecloth bags and immersing them in water so that no air can reach them. The air should be excluded from the bag by gently kneading it in the hands while under water. The amphibians will drown within twelve hours.

After killing, the specimens should be placed in 4% formalin for at least a week to harden. The formalin must be allowed to enter the body cavity or otherwise the internal organs will decompose before the preservative can penetrate to them. This is best accomplished by injecting the formalin into the body cavity, by means of a hypodermic syringe, but if this is not convenient, the abdomen may be slit open with a pair of scissors. When thoroughly hardened, the specimens should be transferred to from 55% to 60% alcohol for permanent storage. It is important that the alcohol be of this strength, for stronger solutions will shrivel them and weaker will not properly preserve them. Each specimen should be provided with a tag tied rather loosely about the body just in front of the hind legs. This label should give the locality, date, name of collector and habitat unless a catalog is kept, in which case a number may be placed on the label and in the notebook with the habitat data.

DESCRIPTION OF SPECIES.

KEY TO MICHIGAN AMPHIBIA.

a¹. Tailed throughout life. *Caudata*.

b¹. External gills persistent in adult. *Proteidae*.

c¹. Body lizard-like. Limbs four, equally developed. External gills. Color brown, spotted with black. Four toes on each foot.....
.....*Necturus maculosus*, p. 23.

b². Adult without external gills. Limbs well developed. Eyelids present. *Mutabilia*.

c¹. No parasphenoid teeth; vomero-palatine teeth in parallel or posteriorly diverging series that do not extend posteriorly over the parasphenoid. Body lizard-like. Costal grooves distinct. Tail compressed. *Ambystomidae*.

- d.¹ Costal grooves 12. Back dark brown with large irregular yellow spots. Body and head stout. Plantar tubercles well developed
Ambystoma tigrinum, p. 26.
- d.² Costal grooves 11. Body and head broad. Back black with series of bright yellow spots on each side of vertebral column. No plantar tubercles. Transverse line of teeth in three parts, central separated from the lateral by a slight interval; central patch usually straight but may curve forward in the middle. *Ambystoma punctatum*, p. 28.
- d.³ Costal grooves 12. Back bluish black, uniform or with pale blue spots. Head and body slender. No plantar tubercles. Teeth in four patches, the two central in a nearly straight line.
Ambystoma jeffersonianum, p. 30.
- c.² Parasphenoid teeth present. Body cylindrical. Tail round, tapering to tip. *Plethodontidae*.
- d.¹ Color brownish black, usually with a broad red or ashy dorsal band. Body slender. Inner toes rudimentary. Costal grooves 16 to 19.
Plethodon erythronotus, p. 32.
- d.² Color light brown spotted with dark, a lighter stripe down the back. Under surface yellowish white with dark inky spots. Body slender. Four toes on each foot. Tail very long, separated from the body by a distinct depression. Costal grooves 13.
Hemidactylium scutatum, p. 34.

c³. Parasphenoid teeth absent. Vomero-palatine teeth in transverse or posteriorly diverging series extending posteriorly over the parasphenoid. Tail compressed. Outer and inner toes on hind foot rudimentary. *Salamandridae*.

d¹. Costal grooves indistinct. Color varying from olive green to reddish brown above.
*Diemictylus viridescens*, p. 36.

a². Tail absent in adult. Body short and broad. Hind limbs adapted for leaping. *Salientia*.

b¹. No maxillary teeth. Parotid glands present. Skin warty. *Bufo*nidae.

c¹. Parotids oval. Cranial crests divergent behind.*Bufo americanus*, p. 39.

b². Maxillary teeth present. Parotid glands lacking. Fingers and toes enlarged at ends to form adhesive disks. *Hylidae*.

c¹. Disks large. Color green, gray or brown with irregular dark blotches. Irregular dark star-shaped blotch on upper part of back.*Hyla versicolor*, p. 41.

c². Disks medium. Oblique dark cross on back. Dark mark between eyes. Limbs barred.*Hyla pickeringii*, p. 43.

c³. Disks small. Color variable with three oblique blotches on sides. Dark triangular spot between eyes. Light line from eye to arm.*Acris gryllus*, p. 45.

c⁴. Disks small, scarcely discernable. Color changeable. Three longitudinal dark stripes on back. Dark line from eye to arm.*Chorophilus nigritus*, p. 47.

b³. Maxillary teeth present. Parotid glands lacking. No adhesive disks. *Ranidae*.

c¹. Lateral folds large. Color green with two irregular rows of rounded dark spots edged with lighter color on back. Legs barred or spotted.*Rana pipiens*, p. 49.

- c². Color brown with two irregular rows of oblong square blotches of dark brown on the back, the spots without edgings of lighter color.....*Rana palustris*, p. 51.
- c³. Lateral folds conspicuous. Color brownish green with small dark spots. Legs spotted or barred with dark. Web broad leaving last two joints of fourth toe free.
.....*Rana clamitans*, p. 53.
- c⁴. Lateral folds present. Ground color variable. Arms and legs barred. A black patch in ear region. Length of hind limb to heel equals distance from anus to some point in front of eye....*Rana cantabrigensis*, p. 55.
- c⁵. No lateral folds. Color light olive brown with blotches of darker color. Legs spotted or branded....*Rana septentrionalis*, p. 57.
- c⁶. No lateral folds. Color greenish brown with darker spots. Fold of skin from eye to arm curving behind ear. Hind feet webbed, leaving last joint of fourth toe free.....
.....*Rana catesbeana*, p. 59.

NECTURUS MACULOSUS Rafinesque.

MUD PUPPY.

(Pl. I.)

Description: Body elongate, thick and cylindrical. Head broad, flat and depressed. Muzzle rounded; mouth large, upper lip overhanging lower. Eyes small, situated near front of head; nostrils at end of snout. Three bushy external gills on each side of neck. Gular fold prominent, fourteen costal furrows and a dorsal groove. Limbs small but well developed, digits four in number. Tail greatly compressed. Skin very smooth and slimy. Two series of teeth in almost parallel rows. Premaxillary series short, forming an angle anteriorly. Vomero-palatine series longer, extending from the angle of the premaxillaries to the angle of the jaw.

Ground color varies from dark to ashy brown above, paler below. Upper surface usually mottled with darker color and with small light spots. Gills bright red. In young specimens a dark lateral band is sometimes found.

Measurements: Specimen No. 41723.

Total length .....	.243
Length of head and body.....	.155
Width of head .....	.034

Habits and Habitat: *Necturus maculosus* is wholly aquatic and is rather dull and sluggish during the day time. It usually rests on the bottom with the gills spread out and may sometimes be seen crawling slowly about. When disturbed, the gills are contracted close to the sides and the animal swims rapidly away by means of the large, flat, paddle-like tail. The fact that it is frequently taken throughout the winter would seem to indicate the absence of a hibernating period.

At night the *Necturus*, which is extremely voracious, swims about in search of its food, which consists mainly of small crustacea, worms, fish and their eggs, and insects. In captivity it will sometimes eat small pieces of meat, but only when it has been for some time without food. It is frequently caught on hooks or in nets by fishermen, who commonly regard it as very poisonous. This fallacy is no doubt due to the coat of slime which is emitted when the animal is irritated. Adult specimens can also inflict a rather painful bite with their sharp, strong teeth, and it is hard to dislodge them when they have secured a good hold. The flesh is reported excellent by those who have eaten it.

Very little is known of the breeding habits of *Necturus*. The animals are usually found in pairs in the autumn, and it is possible that this is the mating season. Hay (1892a, p. 12) states that eggs were taken from the Detroit River about the middle of July, while according to Eycleshymer (1906, p. 133), who has studied their habits in the small lakes of Wisconsin, "the best time for collecting is during the middle and latter parts of the month of May." The nest is much like that of a fish, consisting of a small excavation in the sand under some sheltering object, such as a log, board or stone. The eggs are found attached to this shelter "by the slender stalks of the gelatinous envelopes" (Smith, 1911, p. 191), and cover a surface of from six to twelve inches in diameter. Smith (1911) found the average number of eggs in a nest to be sixty-six. They are about the size of a pea, and lack the pigment which is characteristic of the eggs of most amphibians. Further details of development have not been worked out.

Distribution: Eastern United States, mostly north and west of

the Alleghanies, abundant in the Great Lake region. (Jordan, 1899.)

Michigan: Specimens in the University Museum from Keweenaw (Isle Royale), Dickinson, Cheboygan, Huron, Livingston, Washten-

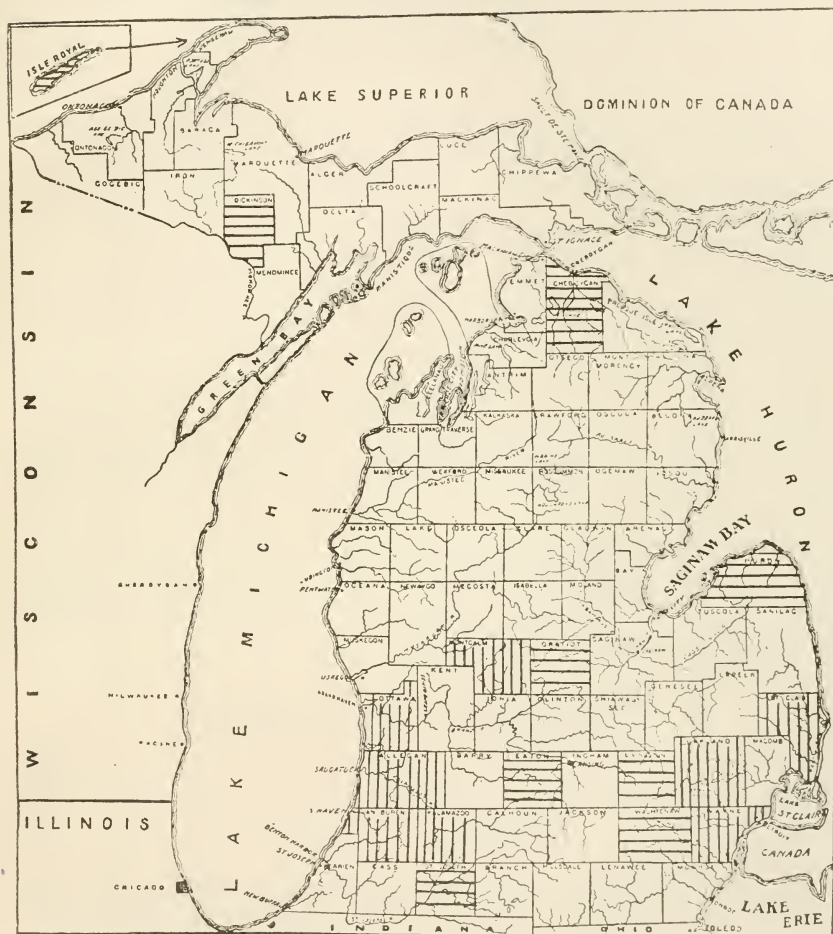


Fig. 3. Distribution of *Necturus maculosus*.

Horizontal ruling, specimens examined; vertical ruling, reports only.

aw and St. Joseph Counties. The writers have also examined specimens from Gratiot and Eaton Counties. Reported from Keweenaw (Isle Royale). Wayne and Oakland Counties (Cope, 1889); Wayne, St. Clair, Allegan, Kalamazoo, Eaton, Montcalm and Van Buren Counties (Gibbs, Notestein and Clark, 1905); Ottawa County (Milner, 1874); Keweenaw County (Isle Royale) (Ruthven,

1909); Cheboygan County (Ruthven, 1911); Huron County (Ruthven, 1911a); Washtenaw County (Smith, 1879); Ottawa and Wayne Counties (Milner, 1874).

AMBYSTOMA TIGRINUM (Green).

TIGER SALAMANDER.

(Pl. II a.)

Description: Body large and thick. Head flat and not as broad as body in adult specimens. Eyes prominent, nares small. Parotid region much swollen. Gular fold prominent, extending upward on sides of neck. Also a groove running from corner of mouth to eye. Twelve costal furrows and a distinct dorsal groove. Limbs stout; toes depressed, tapering from a broad base to the tips which are hardened and horny in appearance. Two distinct plantar tubercles. Tail long and compressed, equal in length to distance from snout to groin. Skin smooth and glossy, and covered with mucous pores which are not as prominent as in *Ambystoma punctatum*. Vomeropalatine teeth in a straight or slightly curving series across roof of mouth. Tongue large and fleshy, free on sides and attached at ends.

Ground color brownish black above, lighter beneath. Bright yellow spots scattered irregularly over entire surface of body. These spots may be few or many in number and are sometimes confluent to form more or less definite stripes.

Measurements: Specimen No. 36030.

Total length .....	.205
Length of head and body.....	.100
Width of head .....	.026

Habits and Habitat: This species, as a rule, spends most of the year under stones, logs, in decaying stumps and in holes or burrows made by other animals. However, it has been known to remain in the water during the summer. It is voracious and carnivorous, eating worms, insects and at times small frogs. According to Metzdorff (Gadow, 1901, p. 113), the breeding season of *Ambystoma tigrinum* is from April to June and occasionally in December. Smith (1882, p. 721) states that "they have been observed in great numbers in the 'Cathole,' at Ann Arbor, Michigan, swimming vigorously on March 10th, and their eggs were found a few days later." The male enters the water and deposits spermatophores, which are

taken up into the cloaca of the female. The eggs are usually laid the day after fertilization, in masses containing from six to ten, and are attached to stems or leaves of water plants. The larvae emerge after an interval of about two weeks. The latter were



Fig. 4. Distribution of *Ambystoma tigrinum*.

Horizontal ruling, specimens examined; vertical ruling, reports only.

formerly supposed to be a distinct species, "Axolotl", due to the fact that metamorphosis may be delayed and breeding take place during the larval stage. Under normal conditions, however, the adult form is reached in about one hundred days after hatching.

Distribution: Northeast to Minnesota and south. (Jordan, 1899.)

Michigan: Specimens in the University Museum from Calhoun, Washtenaw, Lenawee and Livingston Counties. Reported from Wayne and Washtenaw Counties (Cope, 1889); Montcalm, Washtenaw, Kalamazoo, Eaton and Allegan Counties (Gibbs, Notestein and Clark, 1905); Washtenaw County (Smith, 1879; Smith, 1882).

AMBYSTOMA PUNCTATUM (Linnaeus).

SPOTTED SALAMANDER.

(Pl. II a.)

Description: Body short and stout. Head broad and slightly rounded, with parotid region greatly swollen. Eyes prominent, nares small. Gular fold prominent, connected by a ridge with another slight fold behind the eye. Eleven costal furrows and a slight dorsal groove. Limbs moderately developed; toes slightly depressed; plantar tubercles indistinct. Tail compressed, with a well marked indentation along each side. Skin smooth and glossy, surface pitted with mucous pores which are most prominent in the parotid region and on the tail. Transverse line of teeth in three patches, the central separated from laterals by slight interval at inner edges of posterior nares. Central patch may curve forward in the middle.

Ground color blue black or black with large yellow blotches arranged in a more or less irregular row on each side of vertebral column. Legs also spotted. Under surface paler than upper.

Measurements: Specimen No. 35787.

Total length .....	.145
Length of head and body.....	.081
Width of head .....	.0165

Habits and Habitat: *Ambystoma punctatum* is nocturnal in its habits and is found under logs and stones in damp, woody places. It resembles *Ambystoma tigrinum* in its food habits. When in the water the animal swims rapidly by means of the broad, flat tail. Like the other members of the genus, this species goes to the water to deposit its eggs. This migration to the ponds takes place in March or April. The males enter the ponds and deposit spermatophores on sticks and leaves just at the surface of the water. These spermatophores are small, white, mushroom-like bodies, the cap-shaped tops containing the sperm. Several are usually deposited in one place and fertilization probably takes place in the same man-

ner as in *Ambystoma tigrinum*. After fertilization the eggs are laid in oval masses, the whole mass being embedded in gelatine. They are attached to some support in the water, either grass stems or small sticks. When hatched the young larvae are about half an

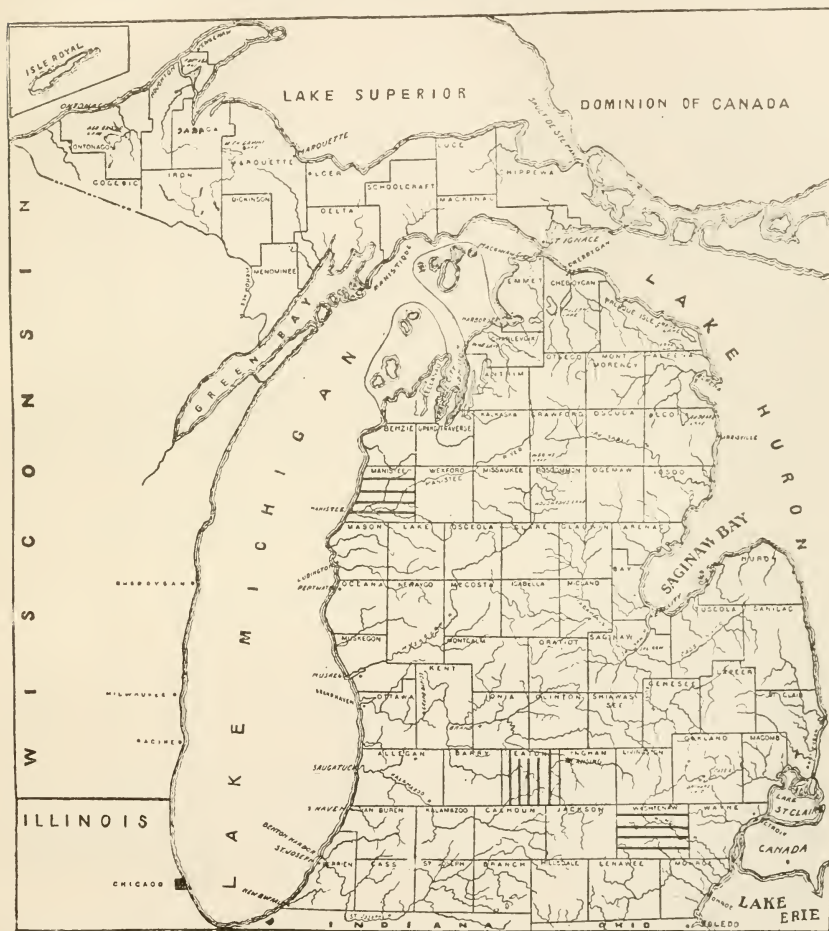


Fig. 5. Distribution of *Ambystoma punctatum*.
Horizontal ruling, specimens examined; vertical ruling, reports only.

inch in length and metamorphosis does not occur until a length of about two inches has been reached.

Distribution: Nova Scotia to Nebraska, south to Georgia. (Jordan, 1899.)

Michigan: Specimens in the University Museum from Manistee and Washtenaw Counties. Reported from Eaton County (Clark,

1902; Gibbs, Notestein and Clark, 1905); Washtenaw County (Smith, 1907; Smith, 1879).

AMBYSTOMA JEFFERSONIANUM (Green).

JEFFERSON'S SALAMANDER.

(Pl. IIa.)

Description: Body long and slender. Head elongate and flat; eyes large and prominent; nares small, situated at end of snout; mouth large. Gular fold distinct, rising on sides of neck. Another fold extends across the throat from a point just behind the corner of the mouth and is met by a groove running from the corner of the eye. Twelve costal furrows and a dorsal groove. Limbs well developed; toes long, slender and much depressed; no plantar tubercles. Tail compressed and somewhat shorter than body. Skin smooth and covered with numerous pores which may be clearly seen under a lens. Teeth in four patches, the two central extending to the inner nares, where they are met by the two lateral patches which form the posterior border of the inner nares. Tongue large and thick.

Ground color bluish or brownish black above, paler below. Surface with or without pale blue spots.

Measurements: Specimen No. 37926.

Total length .....	.118
Length of head and body.....	.070
Width of head.....	.010

Habits and Habitat: *Ambystoma jeffersonianum* is secretive, and during the day is found in damp, dark places. It is usually found under logs and stones. It is extremely active, and, according to Gadow (1901, p. 111), a good climber, "easily escaping out of high-walled bell-glasses."

Little has been done on the breeding habits of this salamander. Smith (1911a, p. 19) states that the early spawning season "suggests the possibility of an autumnal fertilization." Hahn (1908, pp. 550-552) has taken the eggs in late segmentation stages on Feb. 28, at Mitchell, Ind., while Smith (1911a, p. 17) found the first eggs on April 5, at Syracuse, New York. They are laid in small grape-like masses that are usually hung on a leaf or stick. Piersol (1910) has found the number of eggs in a single mass to be about twenty. The hatching probably takes place in from thirteen to

eighteen days and transformation occurs some time during July or August.

This species resembles *Plethodon glutinosus*, which has been reported from Kent (Gibbs, Notestein and Clark, 1905), Wayne (Cope, 1889) and Marquette (Ruthven, 1906) Counties. However,

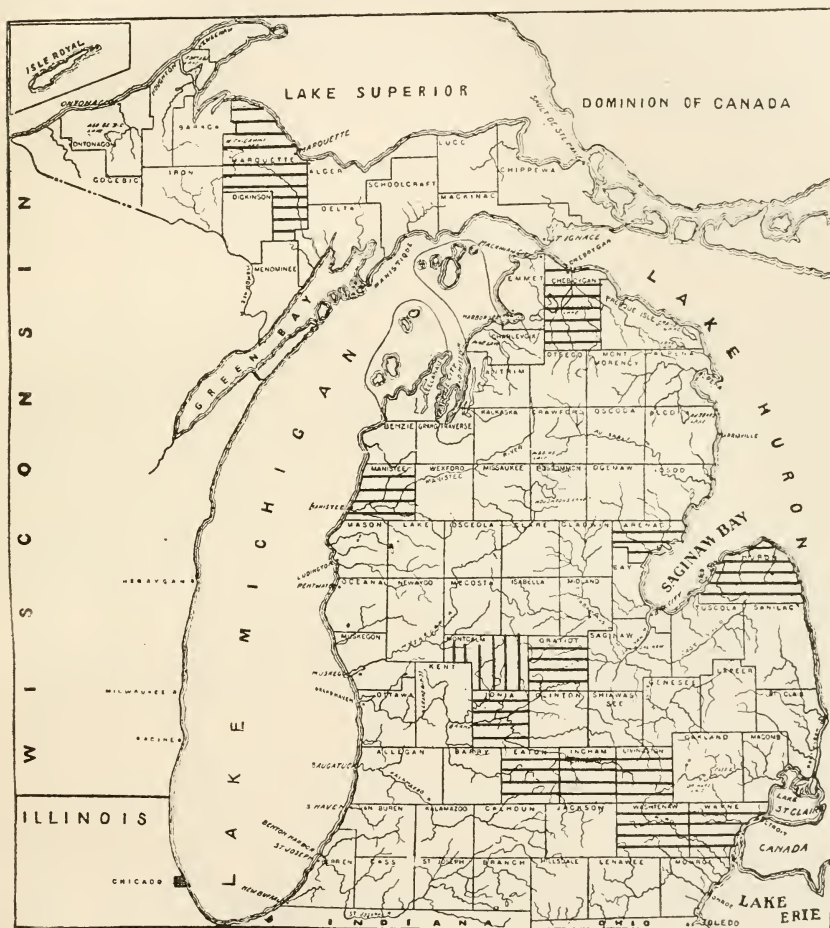


Fig. 6. Distribution of *Ambystoma jeffersonianum*.
Horizontal ruling, specimens examined; vertical ruling, reports only.

the specimens listed from Wayne and Marquette Counties are in the University Museum and have been re-identified as *Ambystoma jeffersonianum*. The two species may be distinguished by the fact that the parasphenoid teeth are present in *Plethodon glutinosus* and absent in *Ambystoma jeffersonianum*. We have not seen specimens of the former from the state.

Distribution: Pennsylvania to Virginia and north to Canada. (Jordan, 1899.)

Michigan: Specimens in the University Museum from Marquette, Cheboygan, Manistee, Arenac (Charity Island), Huron, Ionia, Ingham, Livingston, Wayne and Washtenaw Counties. The writers have also examined specimens from Gratiot and Eaton Counties. Reported from Eaton County (Clark, 1902); Eaton and Montcalm Counties (Gibbs, Notestein and Clark, 1905); Washtenaw County (Smith, 1879); Cheboygan County (Ruthven, 1911); Huron County (Ruthven, 1911a).

PLETHODON ERYTHRONOTUS (Green).

RED-BACKED SALAMANDER.

(Pls. I, IIb.)

Description: Body long, slender and cylindrical. Head small; mouth very large, upper jaw slightly protruding; eyes large; nares small and situated laterally. Gular fold prominent, reaching up to the dorsal stripe and met there by a groove running from the corner of the eye. This groove is in turn bisected by a groove extending upward from the corner of the mouth. Costal folds distinct; the number varying from sixteen to nineteen. A distinct dorsal groove. Limbs extremely slender, inner toes rudimentary. Tail cylindrical. Vomeropalatine teeth extending backward in two converging rows. Parasphenoid teeth in two patches behind the nares.

Color brownish black on sides, usually with a broad ashy or red dorsal stripe which is mottled with brown. Under surface yellowish, also mottled with a darker color.

Measurements: Specimen No. 35804.

Total length .....	.089
Length of head and body.....	.045
Width of head .....	.005

Habits and Habitat: The red-backed salamander is entirely terrestrial in its habits. It is usually found under rocks and in decaying logs in moist, woody places and occasionally on low shrubs and plants. It is very active, the adult disappearing rapidly and hiding under leaves and moss when disturbed, unless accompanied by its young. The food consists mainly of insects, larvae, small snails and worms, which are caught by means of the projectile tongue.

The eggs are found in grape-like bunches of from six to eleven attached to the under surface of stones or the bark of decaying trees and are brooded by the female. They are laid, according to Hahn (1908), in May, but have not been found at Ann Arbor until June (Smith, 1882). The writers took eggs in a late stage of develop-

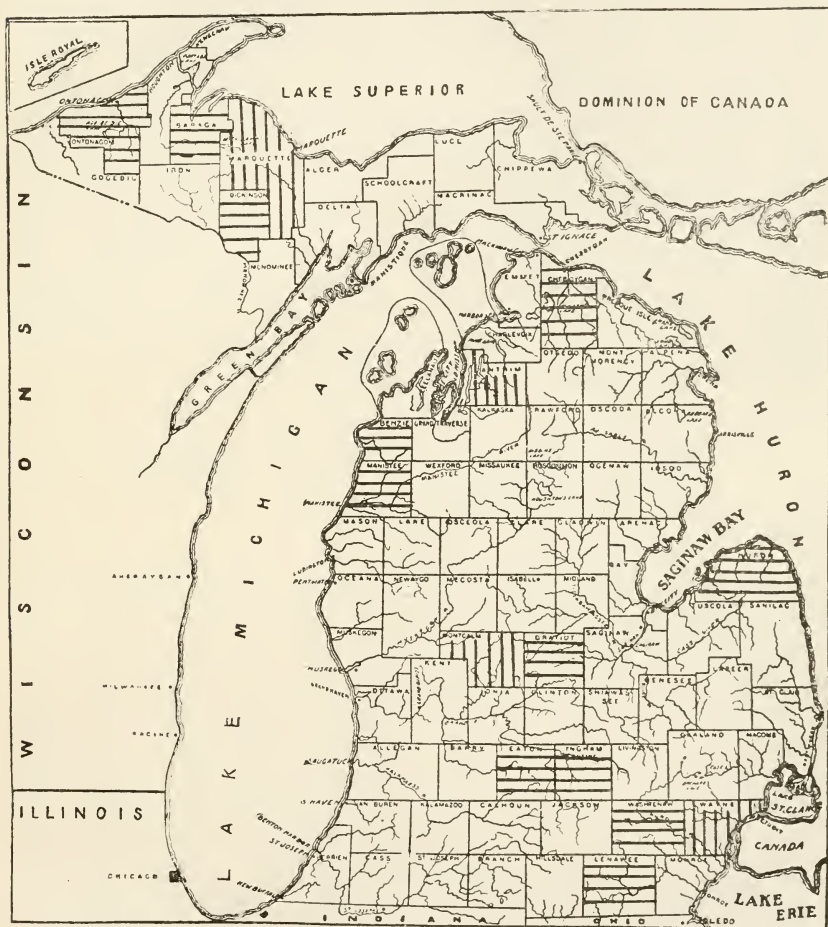


Fig. 7. Distribution of *Plethodon erythronotus*.
Horizontal ruling, specimens examined; vertical ruling, reports only.

ment at Port Austin, Huron County, Aug. 5, 1911. The larvae, which are at first provided with branchiae, are usually found with the parents and are apparently fed by them. When young the animal is very light in color, growing darker with age.

Prof. Cope (1889) recognizes two sub-species of *Plethodon*, *P.*

cinereus and *P. cinereus* var. *erythronotus*, which have both been reported from Michigan. There are no apparent differences in structure, proportions and general character between these two forms. The distinction is entirely one of color, *erythronotus* having a red dorsal stripe, *cinereus* an ashy one. Also, the writers have found the two varieties in the same region, and not infrequently in one log. Without doubt the differences in color are only individual.

Distribution: Eastern United States. (Jordan, 1899.)

Michigan: Specimens in the University Museum from Ontonagon, Baraga, Dickinson, Cheboygan, Benzie, Manistee, Huron, Ing-ham, Washtenaw and Lenawee Counties. The writers have also examined specimens from Gratiot and Eaton Counties. Reported from Eaton County (Clark, 1902); Wayne County (Cope, 1889); Eaton, Montcalm and Antrim Counties (Gibbs, Notestein and Clark, 1905); Ontonagon County (Ruthven, 1904a); Ontonagon, Baraga and Marquette Counties (Ruthven, 1906); Cheboygan County (Ruthven, 1911); Huron County (Ruthven, 1911a); Wash-tenaw County (Smith, 1879; Smith, 1882).

HEMIDACTYLIUM SCUTATUM (Schlegel).

FOUR-TOED SALAMANDER.

(Pl. I.)

Description: Body short and cylindrical. Head broad, muzzle blunt, upper jaw projecting over lower. Eyes large. Gular fold distinct but not prominent, and rising on the sides of the neck. Another depression extending from the eye to the gular fold. Skin with slight depressions that give it a scuted appearance. Thirteen distinct but not prominent costal grooves. A dorsal groove and a slight depression extending along the sides from limb to limb. This lateral depression forks anteriorly and sends out a branch to the middle of the head between the eyes. Limbs very slender but well developed. Toes four in number, the inner toe and inner and outer fingers rudimentary; third toe the longest. Tail very long, separated from body by a distinct depression, slightly compressed, large at base and tapering gradually to a point. Vomeropalatine teeth in two series just behind internal nares. Parasphenoidal patches distinctly separated. Tongue attached anteriorly, and slightly free posteriorly.

Ground color dark brown, spotted with darker color, and becoming dark gray on the sides. Limbs, snout and tail lighter in color than back, and blotched with dark above. Small light spot on shoulder just above arm.

Measurements: Specimen No. 42140.

Total length .....	.067
Length of head and body .....	.031
Width of head .....	.005

Habits and Habitat: The four-toed salamander is a rare species



Fig. 8. Distribution of *Hemidactylium scutatum*.

Horizontal ruling, specimens examined; vertical ruling, reports only.

in Michigan, having been found in only three counties in the state. Clark (1902) reports five specimens, which have been examined by the writers, from Eaton County as follows: "A single specimen of this uncommon salamander was collected May 13, 1901. It was found in the earth on the roots of a violet, which had been pulled up. So far as I can learn, it has not previously been collected in

Michigan. Four other specimens, two males and two females, were taken together in April, 1902, under a log. The females were fully twice as large as the males." There are at present three live specimens in the University of Michigan Museum. One of these was taken in a woods about five miles south of Ann Arbor during the summer of 1910, and was presented to the Museum by Miss Jessie Phelps. The other two specimens were taken by the writers in the same woods in April, 1911. A single specimen was collected by N. A. Wood at White Fish Point, Chippewa County in August, 1912.

Very little is known of the habits of this salamander. Smith (1882, p. 723) states that "it has been found in April under old logs and rails in open woods, at some distance from the water, and was very quick and lively in its movements." The woods in which the Washtenaw County specimens were taken is low and damp. One was found under loose moss and one was just inside the bark of a rotten stump. The movements are lively and erratic, the animal sometimes jumping for some distance. The food probably consists of insects and worms, the writers have observed it to eat small flies in captivity. The eggs are laid under moss or bark, and the salamander, at least in the adult condition, avoids the water. Individuals sometimes emit a sharp squeal when annoyed.

Distribution: From Massachusetts and Canada westward to Illinois and south to Georgia. (Jordan, 1899.)

Michigan: Specimens in the University Museum from Washtenaw and Chippewa Counties. Reported from Eaton County (Clark, 1902; Gibbs, Notestein and Clark, 1905); Washtenaw County (Ruthven, 1911).

DIEMICTYLUS VIRIDESCENS Rafinesque.

GREEN NEWT.

(Pls. I, II a.)

Description: Body slender and slightly compressed. Muzzle rounded; upper jaw extending a little beyond the lower; eyes large; exterior nares close together. Limbs slender, anterior about half the size of the posterior. First finger and first and fifth toes rudimentary. Tail much compressed and as long, if not longer, than the head and body. Skin finely wrinkled; costal grooves indistinct. On either side of the head below the eye there may be a row of four pits, but these are frequently lacking. Vomeropalatine teeth in two longitudinal rows which converge close to the internal

nares. Tongue attached posteriorly and anteriorly but free on the sides.

Ground color varies from reddish brown to olive green above; lower surface pale yellow. Body covered with small black spots especially noticeable on the lower surface because of the lighter ground color. On either side of the vertebral line a row of small red spots, each having a black border.

Measurements: Specimen No. 37937.

Total length .....	.100
Length of head and body .....	.048
Width of head .....	.008

Habits and Habitat: This newt is aquatic in its habits, the adult spending most of its time in the water. It frequents places with a soft bottom and hides under leaves and water plants. In large ponds it is usually found in the more sheltered places. It is carnivorous in food habit and extremely voracious. The food consists chiefly of water insects, small molluscs, worms and tadpoles. When kept in captivity the animal becomes very tame and will readily eat small pieces of meat, worms and small tadpoles. It sometimes emits a sharp squeak when disturbed. The breeding season extends from April to June. During this season the genital openings of the male become swollen, and transverse horny plates appear on the posterior surface of the hind limbs and on the under side of the tips of the toes. A spotted crest also appears along the upper and lower sides of the tail. The male deposits spermatophores similar to those of *Ambystoma punctatum* except that they are fewer in number. In order to insure the fertilization of the eggs there is a preliminary "Liebes spiel". The eggs are laid singly between the leaves of water plants or in other like situations. According to Jordan (1893), the egg laying season for one individual lasts about seven or eight weeks. The young larvae hatch after a period of about thirty days. After the gills are absorbed, the young animal leaves the water and the color changes to a dark red. This stage was formerly considered a distinct species and called *D. miniatus*; careful observation, however, has shown that, after the first two or three years of its life, the animal returns to the water and assumes the adult viridescent coloration.

Distribution: Eastern United States, abundant north and northeast. (Jordan, 1899.)

Michigan: Specimens in the University Museum from Houghton,



Fig. 9. Distribution of *Diemictylus viridescens*.

Horizontal ruling, specimens examined; vertical ruling, reports only.

Marquette, Cheboygan, Huron, Arenac (Charity Island), Ionia and Washtenaw Counties. The writers have also examined specimens from Eaton County. Reported from Eaton County (Clark, 1902; Gibbs, Notestein and Clark, 1905); Cheboygan County (Ruthven, 1911); Huron County (Ruthven, 1911a); Washtenaw County (Smith, 1879).

BUFO AMERICANUS Le Conte.

AMERICAN TOAD.

(Pl. IIIa.)

Description: Body short and depressed. Head very broad, upper jaw protruding slightly and notched in the center. Eyes large. Parotid glands large and kidney shaped. Fronto-parietal crests extend back between the eyes and are joined at right angles by the post-orbital crests which extend back of the eyes to a point above the ears. Skin conspicuously warty above; under surface granulated. Toes partly webbed. Two dark-colored metatarsal tubercles, the outer small, the inner with a cutting edge. Jaws without teeth.

Ground color varies from grayish to brownish black, with large irregular spots of dark brown which show more plainly on the specimens which are lighter in color. There is frequently a light vertebral stripe. Under surface a dusky lemon color, sometimes with smaller irregular blotches of dark brown. Throat of male black.

Measurements: Specimen No. 30114.

Length of head and body.....	.0845
Length of hind limb to heel.....	.0565
Width of head .....	.032

Habits and Habitat: The common American toad is our best known amphibian. This is due to its abundance and to the fact that it is common in gardens and around houses so that it is frequently seen. It appears with the first warm spring days and is found in shaded places until fall, when it burrows into the ground and hibernates until spring. It is nocturnal in habit, coming out in the dusk of evening to search for food, which consists mostly of insects and their larvae. During the day it sits in its burrow, which it makes by backing into the soft earth or dense vegetation, and sleeps. It is so protectively colored that it is usually very hard to distinguish from the clods of earth or the background of partially shaded vegetation in its usual haunts.

The popular belief that toads are poisonous is erroneous. On the contrary they are very beneficial to man, since about 88% of their food consists of garden pests. They may at times, especially when roughly handled, excrete a colorless, odorless and harmless fluid from the skin, which makes them somewhat moist. There is also an excretion from the parotid gland region, and this is slightly

poisonous if taken internally. The latter affects the mucous membrane of the mouth and protects the toad when seized by dogs and other enemies.

The breeding season lasts from April to July. The first specimen observed by the writers in 1911 was found on the evening of April

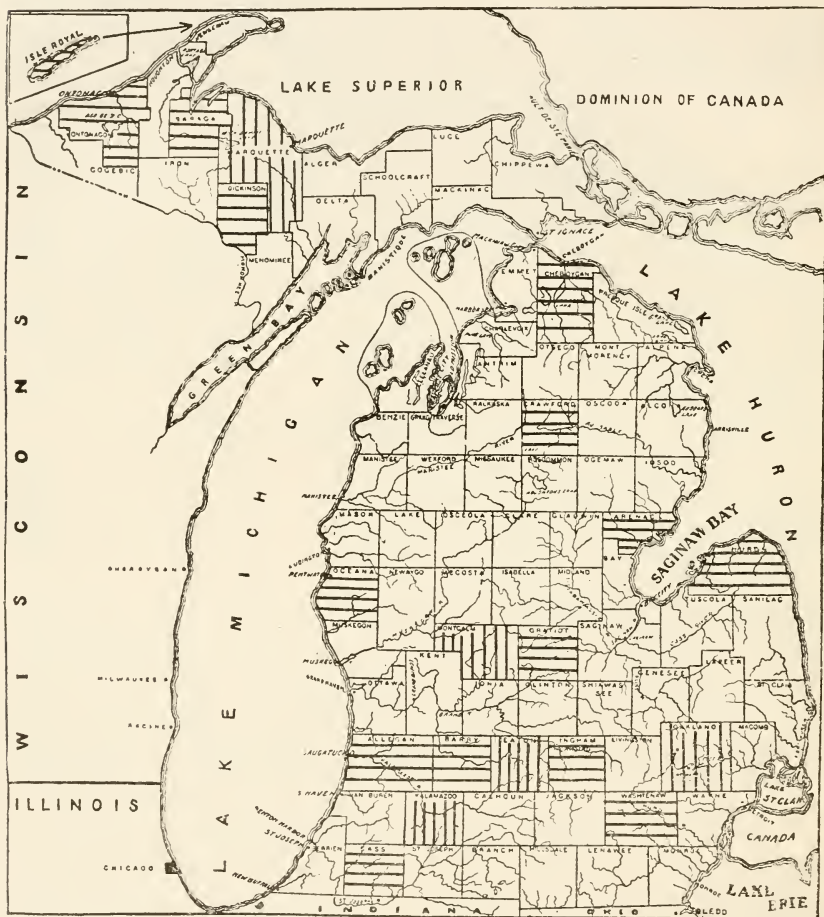


Fig. 10. Distribution of *Bufo americanus*.
Horizontal ruling, specimens examined; vertical ruling, reports only.

26, and the next day large numbers were seen on their way to the ponds. The males seem to outnumber the females and struggle together for their possession. When disturbed, the male utters a peculiar chirping sound somewhat like the scolding of a chicken. The song consists of a sweet high trill that is bird-like in its quality.

The eggs are laid in the water in two very long strands each consisting of a row of eggs embedded in a gelatinous mass. They hatch in about four days, and the larvae remain in the water until the final metamorphosis which occurs in July. The toad does not start breeding until it is about four years old, and it may live for many years. Miss Dickerson tells of one that lived for thirty-six years and then was killed by an accident.

Distribution: Eastern North America, west to Arizona and Mexico. (Dickerson, 1906.)

Michigan: Specimens in the University Museum from Keweenaw (Isle Royale), Baraga, Ontonagon, Dickinson, Cheboygan, Crawford, Oceana, Arenac (Charity Island), Huron, Ingham, Washtenaw, Barry, Allegan and Cass Counties. The writers have also examined specimens from Gratiot County. Reported from Eaton County (Clark, 1902); Ontonagon County (Cope, 1889); Eaton, Kalamazoo, Washtenaw and Montcalm Counties (Gibbs, Notestein and Clark, 1905); Oakland County (Hankinson, 1908); Ontonagon County (Ruthven, 1904a); Keweenaw (Isle Royale), Ontonagon, Baraga and Marquette Counties (Ruthven, 1906); Keweenaw County (Isle Royale) (Ruthven, 1909); Cheboygan County (Ruthven, 1911); Huron County (Ruthven, 1911a); Cass County (Thompson, 1911).

HYLA VERSICOLOR Le Conte.

COMMON TREE FROG.

(Pl. IIIb.)

Description: Form toad like. Muzzle blunt in outline. Eyes prominent. Toes webbed nearly to tips; fingers and toes with large adhesive disks. Upper surface of body slightly warty. Lower surface granulated. A large fold of skin across the chest. Vomeropalatine teeth in two patches just behind internal nares. Tongue very large and fleshy, slightly notched behind.

Ground color gray, green or brown with irregular dark blotches. A large irregular dark star on upper part of back. Limbs barred with dark brown. A dark ear patch and a light spot under the eye. Under parts pale yellow, brighter posteriorly. Throat sometimes mottled with darker. Concealed leg surfaces vermiculated with brown.

Measurements: Specimen No. 30805.

Length of head and body.....	.044
Length of hind limb to heel.....	.0375
Width of head.....	.0165

Habits and Habitat: The common tree frog, or tree toad as it is frequently called, is the most familiar of our Hylidae. It lives for the most part in trees, bushes and vines. It is not confined to the woods alone but lives also in orchards and in the vines around



Fig. 11. Distribution of *Hyla versicolor*.
Horizontal ruling, specimens examined; vertical ruling, reports only.

houses. The large size of the disks on the fingers and toes allow it to cling to smooth vertical surfaces and enable it to catch and hold to branches when it climbs from place to place among the trees and bushes. It is more active toward night when it is searching for food. The latter consists of insects and larvae, found on the tree in whose leafy branches it makes its home. In the winter it

hibernates in hollows of trees or in the moss at their roots. This species has the power of changing its color, although the change is not rapid. There is a range of colors from very light yellow and green to dark brown and green. The color, under ordinary circumstances, corresponds with that of the object on which the frog is resting. The eggs are laid in May, in small groups or singly. They are attached to water plants or grass stems and hatch in about forty-eight hours. After hatching, the development is rapid, the final metamorphosis taking place in about seven weeks.

Distribution: Canada, south to Texas and Kansas. (Dickerson, 1906.)

Michigan: Specimens in the University Museum from Dickinson, Cheboygan, Oceana, Huron, Livingston, Oakland, Washtenaw, Wayne and Cass Counties. Reported from Eaton County (Clark, 1902); Washtenaw and Wayne Counties (Cope, 1889); Eaton, Montcalm, Kent, Ottawa, Barry and Van Buren Counties (Gibbs, Note-stein and Clark, 1905); Oakland County (Hankinson, 1908); Marquette County (Ruthven, 1906); Huron County (Ruthven, 1911a); Cass County (Thompson, 1911).

HYLA PICKERINGII Holbrook.

SPRING PEEPER.

(Pl. IIIb.)

Description: Body short and stout. Muzzle pointed, upper jaw extending beyond lower. Ears small. Feet moderately webbed, disks relatively large. Under surface granulated. A fold of skin across the chest. Vomeropalatine teeth in two patches behind internal nares. Tongue large, slightly notched, and free behind.

Ground color varies from light to dark brown. A dark V between the eyes and a large oblique dark cross on the back. Limbs indefinitely barred with darker. A dark band from the snout through the eye to the side. Under surface pale yellow, granulated, darker posteriorly. Usually darker blotches on throat and chest.

Measurements: Specimen No. 37906.

Length of head and body.....	.021
Length of hind limb to heel.....	.0155
Width of head .....	.0065

Habits and Habitat: The spring peeper is the smallest of the Hylidae. During the summer it may be found among fallen leaves

and moss in damp places, the color being admirably adapted for concealment in such situations. Its search for food, which consists mainly of small insects and worms, may frequently take it to gardens and orchards, and it has even been found in greenhouses.



Fig. 12. Distribution of *Hyla pickeringii*.

Horizontal ruling, specimens examined; vertical ruling, reports only.

During the winter months it hibernates under the moss and leaves or in hollow trees. The breeding season begins early and lasts until May. The frogs sing in chorus and their bird-like call is one of the most familiar sounds of spring. The male croaks when hidden under moss or grass. The eggs are laid in April, usually singly, though occasionally in small masses, and are attached to water

plants. They are very small, "so small that they look like tiny plant seeds" (Dickerson, 1906, p. 145). The time of development varies from six to twelve days according to the temperature, and metamorphosis takes place in about two months after hatching, the little tadpoles usually leaving the water before the transformation is completed.

Distribution: Eastern North America, Canada to South Carolina. (Dickerson, 1906.)

Michigan: Specimens in the University Museum from Keweenaw (Isle Royale), Ontonagon, Dickinson, Houghton, Baraga, Huron, Washtenaw, Cass and St. Joseph Counties. Reported from Eaton County (Clark, 1902); Wayne and Washtenaw Counties (Cope, 1889); Van Buren, Eaton, Kalamazoo, Antrim and Montcalm Counties (Gibbs, Notestein and Clark, 1905); Ontonagon County (Ruthven, 1904a); Ontonagon, Baraga, and Houghton Counties (Ruthven, 1906); Keweenaw County (Isle Royale) (Ruthven, 1909); Huron County (Ruthven, 1911a); Cass County (Thompson, 1911).

ACRIS GRILLUS Le Conte.

CRICKET FROG.

Description: Form frog like. Muzzle very long and pointed. Disks on fingers and toes small, scarcely noticeable. Toes webbed almost to tips. Sole tubercles moderate in size. Skin above with numerous conspicuous smooth warts. Under surface slightly granulated posteriorly. A fold of skin across the chest. Vomerine teeth in two patches between internal nares. Tongue attached in front and along mid-line.

Ground color variable, usually brown or green with a dark triangular mark between the eyes. Three oblique blotches on the sides. Limbs barred or spotted with dark. A light line from eye to arm. Upper lip light spotted with darker. Concealed surface of femur with a longitudinal dark stripe. Under surface yellowish white, throat mottled with darker. Coloration of male may be so dark that markings do not show.

Measurements: Specimen No. 30473.

Length of head and body.....	.024
Length of hind limb to heel.....	.025
Width of head .....	.0085

Habits and Habitat: The cricket frog is a tree frog that is en-

isolated call may be heard all summer. The song resembles the chirping of a cricket, hence the common name, cricket frog. The eggs are laid in April or May. The development is rather slower than that of the rest of the Hylidae. Miss Dickerson has found the tadpoles in the water in August and thinks that metamorphosis takes place in September.

Distribution: New York to Florida, west to Texas. (Dickerson, 1906.)

Michigan: Specimens in the University Museum from Cheboygan, Livingston, Washtenaw, Calhoun, Allegan and St. Joseph Counties. Reported from Eaton County (Clark, 1902); Antrim and Eaton Counties (Gibbs, Notestein and Clark, 1905); Cass County (Thompson, 1911).

CHOROPHILUS NIGRITUS (Le Conte).

SWAMP TREE FROG.

(Pl. IV a.)

Description: Body frog like. Head long and pointed; upper jaw protruding. Eyes prominent. Toes slightly webbed; disks small, hardly noticeable. A conspicuous fold across chest. Skin granulated on back and lower surface. Vomeropalatine teeth near the posterior part of internal nares. Tongue medium in size.

Ground color changeable, varying from light to dark brown. A dark stripe begins at the snout and runs back through the eye to the posterior part of the body. Upper lip with a light stripe and bordered with dark. Usually three dark longitudinal stripes on the back; center stripe on the vertebral line and sometimes forking posteriorly and behind the eyes. Limbs indistinctly barred or spotted. Under surface yellowish white. Throat of male yellow.

Measurements: Specimen No. 37921.

Length of head and body.....	.017
Length of hind limb to heel.....	.015
Width of head .....	.006

Habits and Habitat: The swamp tree frog is found in marshes and damp places throughout the summer and fall. During this time it is solitary and its call is rarely heard. It is also seldom seen because of the small size and protective coloration. When disturbed it disappears in the water, but it is a very poor swimmer

and soon comes back to land. This species is probably, like *Acris gryllus*, unable to climb trees because of the small size of the disks on the fingers and toes. The food consists of small insects. It comes from its hibernation early. The song is very loud. When

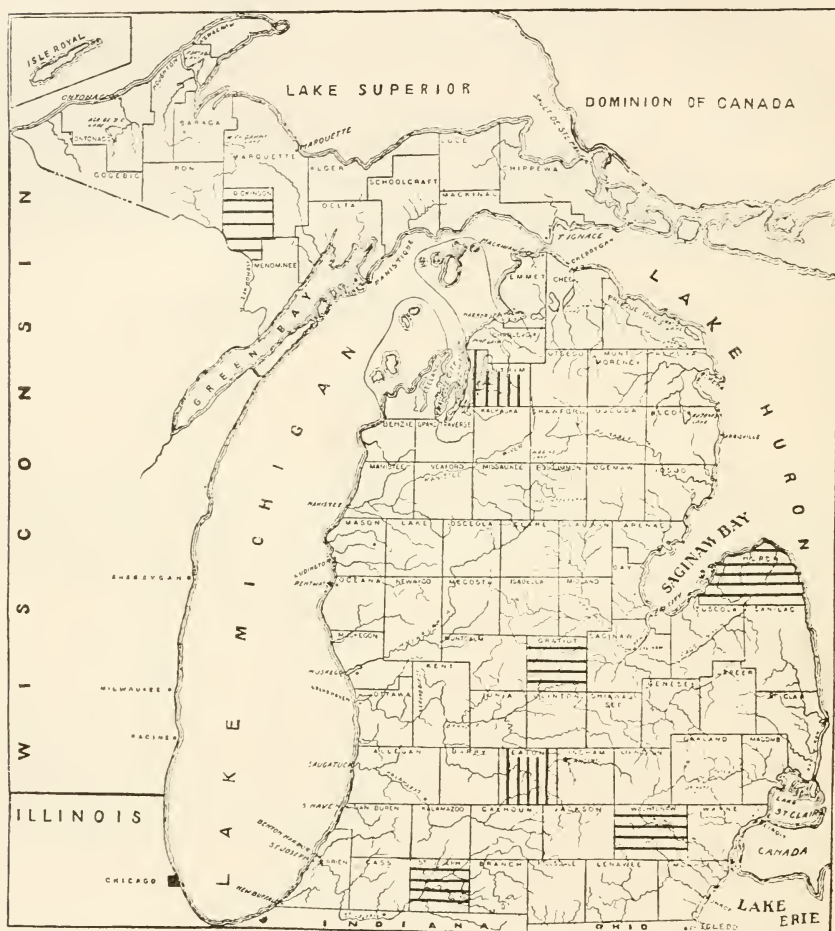


Fig. 14. Distribution of *Chorophilus n. gritus*.
Horizontal ruling, specimens examined: vertical ruling, reports only.

croaking, the male sits upright in the water, supporting himself with grass, leaves or twigs, and sings with the head and vocal pouch out of the water. When disturbed, he sits perfectly still and does not resume his song until the source of alarm has passed. The eggs are laid in March or April in small masses containing from five to twenty, and are attached to water plants. The development

is rapid, the eggs hatching in about two weeks. Metamorphosis is completed early in June.

Distribution: Entire United States and north in Canada to the Hudson Bay region. (Dickerson, 1906.)

Michigan: Specimens in the University Museum from Dickinson, Huron, Washtenaw and St. Joseph Counties. The writers have also examined specimens from Gratiot County. Reported from Eaton County (Clark, 1902); Antrim and Eaton Counties (Gibbs, Notestein and Clark, 1905); Huron County (Ruthven, 1911a).

RANA PIPIENS Shreber.

LEOPARD FROG.

(Pl. IV b.)

Description: Body long and slender. Head long and pointed at the snout. Lateral folds prominent; there may be several smaller folds between them. Skin smooth above; under surface of thighs slightly granular. A glandular fold extending from corner of mouth over the shoulder. Legs long and very powerful; feet partly webbed, webs deeply indented. Tubercles under joints of toes prominent. Vomerine teeth in two patches between internal nares.

Ground color green, gray or brown above. Lateral folds lighter; between them two irregular rows of rounded dark spots edged with lighter. Several rows of smaller rounded spots below lateral folds. Under surface yellowish white, frequently with dark spots across pectoral region. A dark line extending from muzzle to shoulder through eye; light lines above and below the darker line make the latter more noticeable. Upper surfaces of limbs transversely barred or blotched with darker. Concealed surface of femur vermiculated with brown.

Measurements: Specimen No. 37869.

Length of head and body.....	.087
Length of hind limb to heel.....	.077
Width of head .....	.022

Habits and Habitat: The leopard frog is the best known of the Ranidae, because of its great numbers and its habit of travelling away from the ponds into the fields in search of food. Its green coloring probably serves as a protection from its enemies. The leopard frog also possesses the power of changing the ground color to a limited degree to suit the surroundings. When kept in the lab-

the shallow water of ponds in large masses which may float freely in the water but are usually attached to sticks or plants. Hankinson (1908) found unsegmented eggs, which had evidently been recently deposited, in Oakland County, April 8, 1907. The time of hatching varies according to temperature, but under ordinary conditions the tadpole will appear in about ten days. The metamorphosis is completed in July or August and it is for this reason that this species is more apt to be raised than *Rana catesbeana* by dealers. Its legs are esteemed as an article of food, and it is also reared or collected in considerable numbers to supply biological laboratories.

Distribution: Common in North America, east of Sierra Nevada Mountains. (Dickerson, 1906.)

Michigan: Specimens in the University Museum from Houghton, Ontonagon, Iron, Dickinson, Cheboygan, Crawford, Iosco, Arenac (Charity Island), Huron, Oceana, Barry, Oakland, Livingston, Washtenaw, Allegan, Calhoun, Kalamazoo, Cass and St. Joseph Counties. The writers have also examined specimens from Gratiot County. Reported from Eaton County (Clark, 1902); St. Clair County (Cope, 1889); Eaton, Van Buren, St. Joseph, Montcalm, Kent, Ottawa, Antrim, Kalamazoo and Barry Counties (Gibbs, Notestein and Clark, 1905); Oakland County (Hankinson, 1908); Ontonagon County (Ruthven, 1904a); Ontonagon, Houghton and Marquette Counties (Ruthven, 1906); Cheboygan County (Ruthven, 1911); Huron County (Ruthven, 1911a); Cass County (Thompson, 1911).

RANA PALUSTRIS Le Conte.

PICKEREL FROG.

(Pl. IV b.)

Description: Body slender. Lateral fold very broad but not elevated. Skin more or less smooth. Under surface of thighs slightly granular. Eyes prominent. Glandular fold from eye to shoulder. No external vocal pouch.

Ground color always some shade of brown, with two rows of more or less square spots of dark brown between the lateral folds, and two rows of smaller brown spots beneath. Lateral folds lighter than ground color. Under surface white anteriorly, bright yellow posteriorly. The yellow may extend along the sides and out under the fore arms. A conspicuous light line from eye to shoulder. Upper surface of limbs barred with brown. Jaws marked as in *R. pipiens*. A brown spot on the snout and one above each eye.

Measurements: Specimen No. 41911.

Length of head and body.....	.070
Length of hind limb to heel.....	.061
Width of head .....	.019

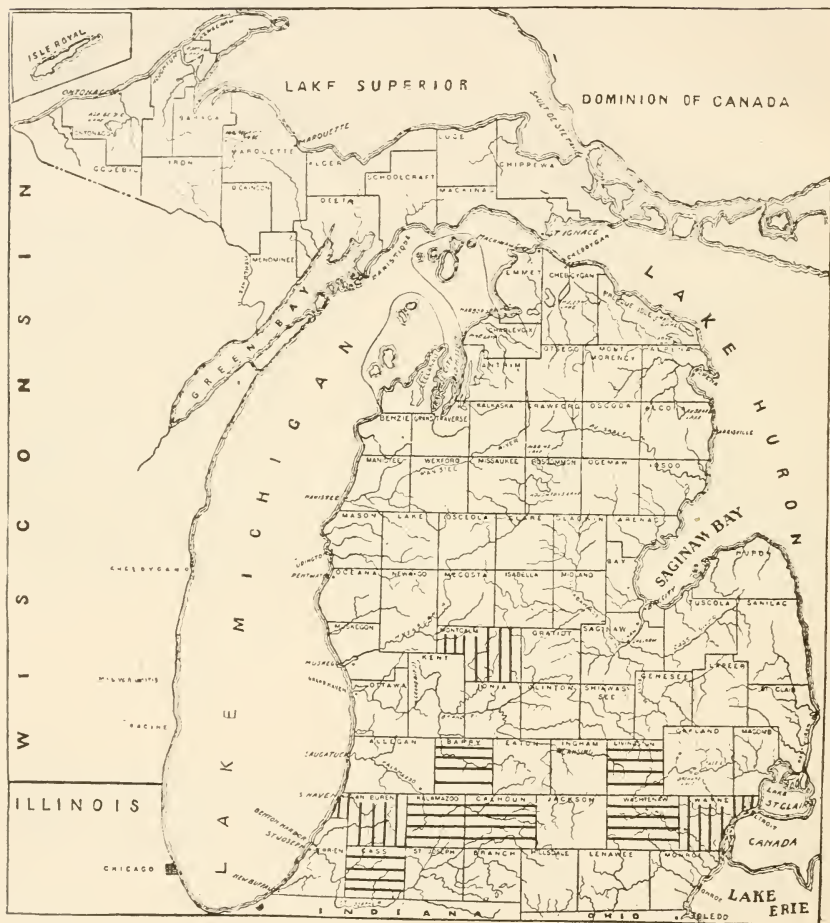


Fig. 16. Distribution of *Rana palustris*.
Horizontal ruling, specimens examined; vertical ruling, reports only.

Habits and Habitat: In habits *Rana palustris* closely resembles *Rana pipiens*. It lives along streams, ditches, about cold springs and ponds, and is very hard to capture because of its great agility and its protective coloration. When resting on a pile of dried leaves, such as is often found along the banks of streams or ponds,

it is almost impossible to distinguish the frog from its surroundings. When frightened it makes several long leaps in quick succession. The food probably consist of insects, small crustacea and snails. The common name "pickerel frog" is due to the fact that the species is frequently used as bait in pickerel fishing. It is of no food value because of the disagreeable odor.

The breeding season of *Rana palustris* is April and May. The croaking of the males is said to resemble the sound made by the tearing of coarse cloth. The eggs are laid during May and the early development is rapid. The metamorphosis usually takes place in July or August, but under adverse conditions transformation may be delayed until the next year.

Distribution: Eastern North America, north to Hudson's Bay and west to the Great Plains. (Dickerson, 1906.)

Michigan: Specimens in the University Museum from Washtenaw, Barry, Calhoun, Kalamazoo, Livingston and Cass Counties. Reported from Wayne County (Cope, 1889); Wayne, Kalamazoo, Montcalm and Van Buren Counties (Gibbs, Notestein and Clark, 1905); Ontonagon County (Ruthven, 1904a); Washtenaw County (Smith, 1879); Cass County (Thompson, 1911).

This species has been reported from Michigan by several writers, but until this year there were, with the exception of one from Livingston County, no specimens in the University Museum. The writers have found it to be rather common in the vicinity of Ann Arbor, and have taken it in Kalamazoo and Calhoun Counties and in large numbers in Cass County (Thompson, 1911), and have received two specimens collected by Miss Jessie McNall in Barry County, so that the species is without doubt quite common throughout the southern part of the southern peninsula. The Ontonagon record is erroneous and the other records need to be verified for the species is easily confused with *R. pipiens*.

RANA CLAMITANS Latreille.

GREEN FROG.

(Pl. V.)

Description: Body stout. Head thick, muzzle pointed. Eyes large and close together. Skin of back rough. Back of femur granulated. Lateral folds conspicuous. Toes broadly webbed, leaving last two joints of fourth toe free. Tubercles on joints of toes and inner sole tubercles distinct. Ear of male larger than eye. Vomerine teeth in two patches between or behind the internal nares.

Ground color variable, usually brownish green with small dark spots. Head and shoulders bright green. Sometimes a light band, widening anteriorly, from shoulder to jaw. Limbs barred with darker. Posterior part of femur finely vermiculated with brown. Under surface yellowish white, throat of female spotted.

Measurements: Specimen No. 36827.

Length of head and body.....	.079
Length of hind limb to heel.....	.062
Width of head .....	.028

Habits and Habitat: The green frog is thoroughly aquatic in its habits, never travelling far from the water. It may be found along the edge of small streams, pools and cold springs. It is rather solitary and timid, when frightened disappearing quickly in the water. It is very much like the bullfrog in appearance and habits, but may be readily distinguished by the lateral folds and the smaller webs on the feet. The food consists of insect larvae, small crustaceans, small frogs and insects. It comes early from hibernation. The song, which is low pitched and explosive in character, is usually heard in March. The eggs are laid in April, in large masses supported in the water by twigs or water plants. The early development is rapid, but metamorphosis is delayed till the second summer and sometimes the third. Hay (1892a) states that the tadpoles are vegetarians and never carnivorous.

Distribution: Common throughout eastern North America, including Canada and Florida. (Dickerson, 1906.)

Michigan: Specimens in the University Museum from Keweenaw (Isle Royale), Baraga, Ontonagon, Houghton, Dickinson, Cheboygan, Crawford, Alcona, Iosco, Arenac (Charity Island), Huron, Oceana, Barry, Livingston, Oakland, Wayne, Washtenaw, Cass and St. Joseph Counties. The writers have also examined specimens from Gratiot County. Reported from Eaton County (Clark, 1902); St. Clair and Wayne Counties (Cope, 1889); Eaton, Van Buren, Antrim, Kalamazoo and Montcalm Counties (Gibbs, Notestein and Clark, 1905); Oakland County (Hankinson, 1908); Lenawee County (Kirsch, 1895); Baraga and Ontonagon Counties (Ruthven, 1906); Keweenaw County (Isle Royale) (Ruthven, 1909); Cheboygan County (Ruthven, 1911); Huron County (Ruthven, 1911a); Cass County (Thompson, 1911).

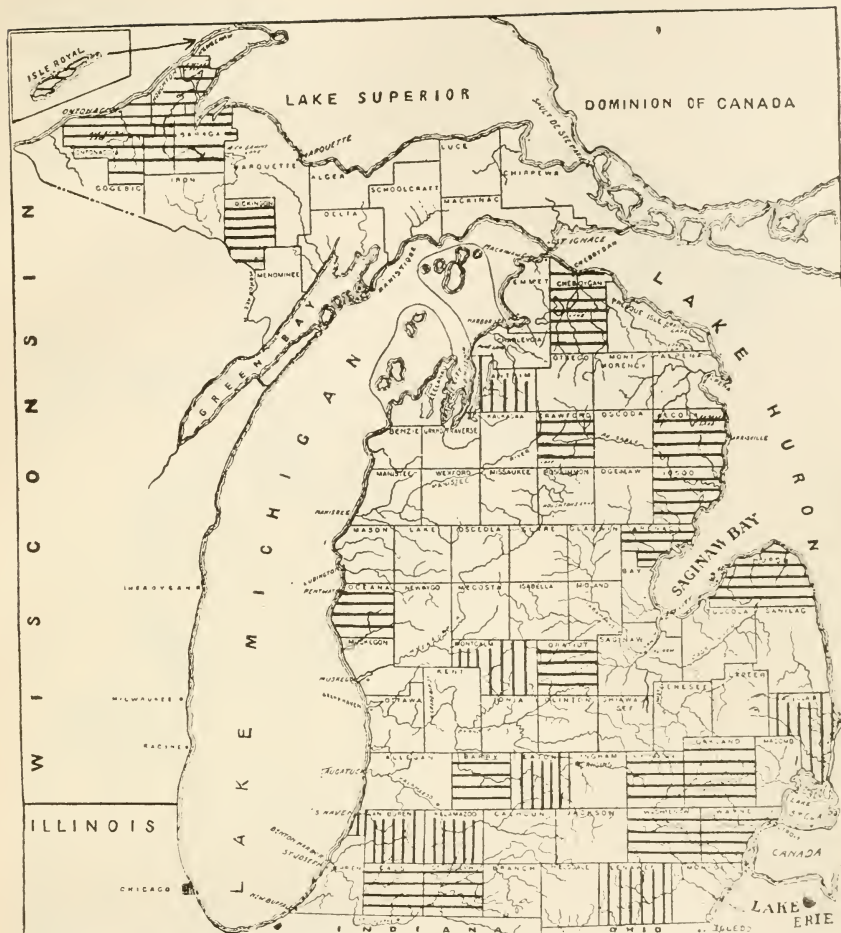


Fig. 17. Distribution of *Rana clamitans*.
Horizontal ruling, specimens examined; vertical ruling, reports only.

RANA CANTABRIGENSIS Baird.

WOOD FROG.

(Pl. IV a.)

Description: Body slender, muzzle pointed. Upper surface slightly granulated; posterior surface of femur granular. Lateral folds conspicuous. Toes long and slender, webbed almost to the tip. Inner sole tubercle present. Vomerine teeth in two patches between or behind internal nares.

Ground color varies from light to reddish and dark brown. Tri-

angular dark spot back of eye covering ear. Light line along upper jaw reaching to shoulder. Limbs barred. Sides may be obscurely spotted with dark. Concealed surface of femur vermiculated. Under surface yellowish white, sometimes mottled with dark.

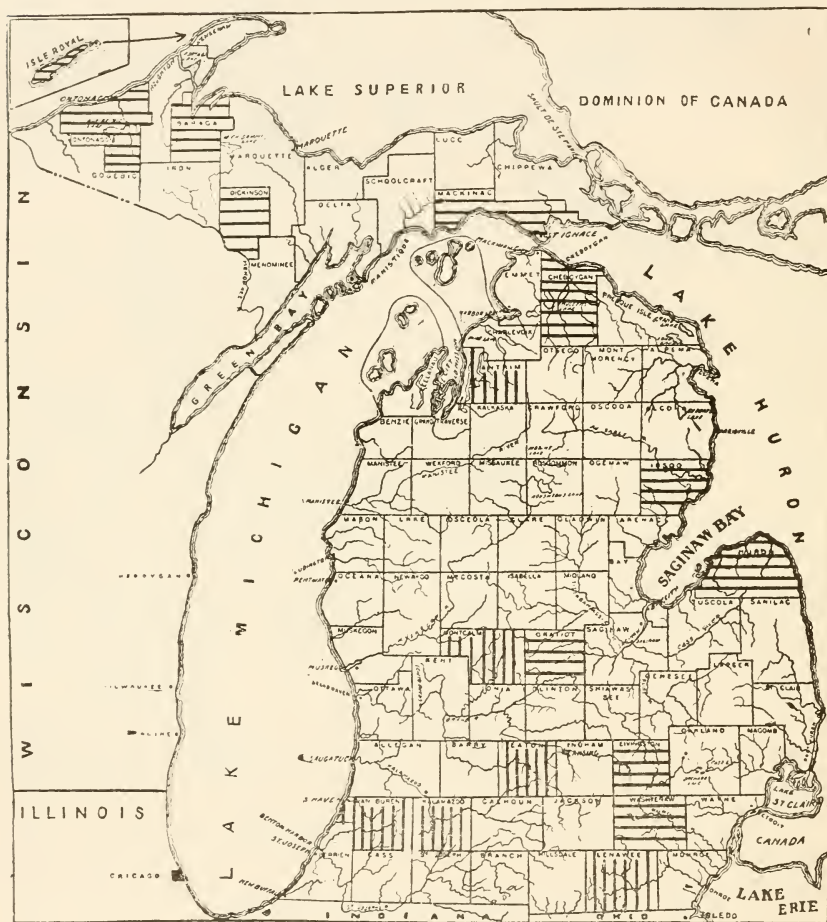


Fig. 18. Distribution of *Rana cantabrigensis*.
Horizontal ruling, specimens examined; vertical ruling, reports only.

Measurements: Specimen No. 34243.

Length of head and body.....	.039
Length of hind limb to heel.....	.032
Width of head .....	.014

Habits and Habitat: The northern wood frog, *Rana canta-*

brigensis, is one of the most terrestrial of our frogs and is usually found in thick, wooded places, among dead leaves or moss. It is very difficult to see because of the protective coloration, the dark brown or grayish coloring blending into the surroundings to such an extent that one may almost step on individuals before seeing them, and the black ear patch and the light line along the side of the head also seem to be protective. When disturbed the frog is very active, leaping quickly away. It becomes very tame in captivity. The wood frog is among the first of the Ranidae to come out in the spring. The hoarse clacking song of the males may be heard during the latter part of March and early in April. The male has no external vocal pouch, but the throat and the parts of the body over the lungs expand. Unlike the males of other species, he floats or swims in the water while croaking. The eggs are laid in ponds, either in the woods or fields, in masses which are usually attached to water plants. They are very small and are surrounded by a gelatinous envelope. The time of development varies greatly according to temperature. Eggs brought into the laboratory hatch in four days, but the development of those left in the ponds is much slower. Metamorphosis usually takes place some time during May or June. The young tadpoles are very carnivorous, living mostly on decaying animal matter in the ponds.

Distribution: Northern. "Reported from Illinois, Michigan, Wisconsin and Minnesota northward to Great Slave Lake on the west and St. James Bay on the east." (Dickerson, 1906, p. 212.)

Michigan: Specimens in the University Museum from Keweenaw (Isle Royale), Ontonagon, Baraga, Dickinson, Mackinac, Cheboygan, Iosco, Huron, Livingston and Washtenaw Counties. The writers have also examined specimens from Gratiot County. Reported from Eaton County (Clark, 1902); Eaton, Kalamazoo, Antrim, Van Buren and Montcalm Counties (Gibbs, Notestein and Clark, 1905); Lenawee County (Kirsch, 1895); Ontonagon County (Ruthven, 1904a); Keweenaw (Isle Royale), Baraga and Ontonagon Counties (Ruthven, 1906); Keweenaw County (Isle Royale) (Ruthven, 1909); Cheboygan County (Ruthven, 1911); Huron County (Ruthven, 1911a).

RANA SEPTENTRIONALIS Baird.

NORTHERN FROG.

Description: Body stout. Head rounded, narrow in front. Eyes large and close together. Skin smooth, slightly granulated on sides and posterior part of femur. Feet fully webbed. Inner sole tuber-

cle large with cutting edge. Vomerine teeth in two patches just behind internal nares.

Ground color light olive brown, usually with large dark brown blotches. Upper surface of jaw from snout to eye lighter in color.

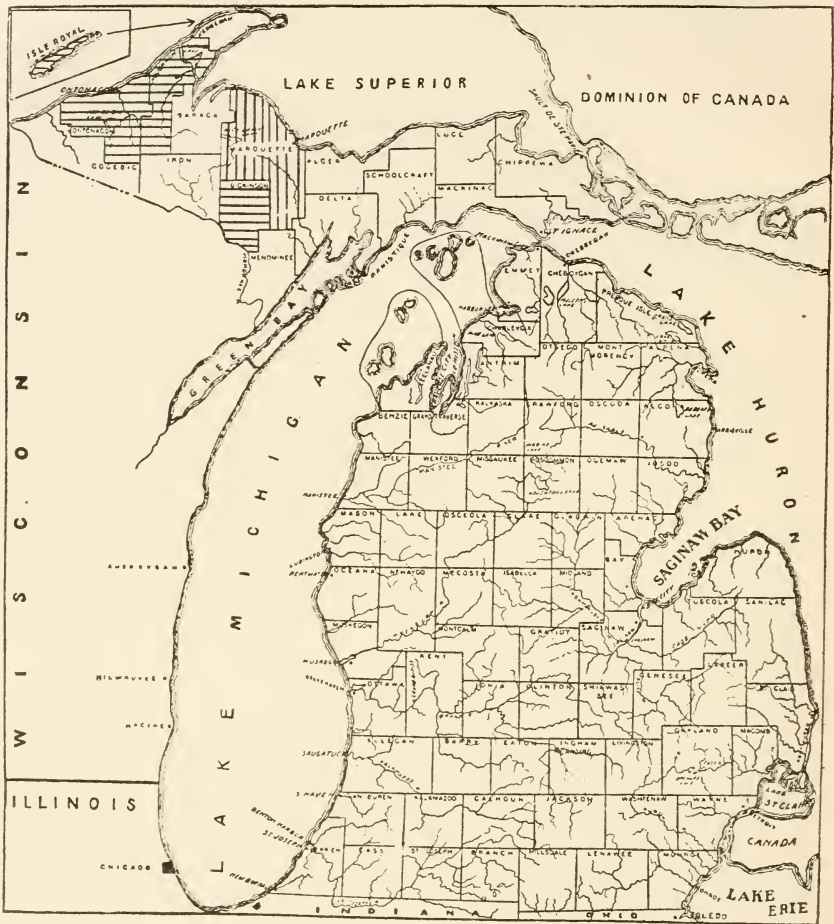


Fig. 19. Distribution of *Rana septentrionalis*,
Horizontal ruling, specimens examined; vertical ruling, reports only.

Large irregular blotches or bands on limbs. Under surface light yellow. Concealed surface of femur strongly vermiculated with brown.

Measurements: Specimen No. 40275.

Length of head and body.....	.062
Length of hind limb to heel.....	.051
Width of head.....	.020

Habits and Habitat: The northern or mink frog is distinctly aquatic. It has been said not to frequent lakes or ponds, but in the Northern Peninsula Ruthven (1910) has found it more characteristic of the inland lakes than of the streams. When frightened, it stays for a long time under water. It is solitary in habits, and never strays far from the shores of the rivers and lakes. The food consists of water insects and small fish. The eggs of this frog are laid in June and July, and are attached to water plants. Two years are required for the full development and metamorphosis (Dickerson, 1906, p. 225). When annoyed it gives off a strong musky odor, somewhat resembling that of the mink, and because of this odor it is frequently called the "mink frog."

Distribution: Adirondack Mountains to Minnesota and Ontario. (Dickerson, 1906.)

Michigan: Specimens in the University Museum from Keweenaw (Isle Royale), Ontonagon, Houghton and Dickinson Counties. Reported from Ontonagon and Marquette Counties (Ruthven, 1906); Keweenaw County (Isle Royale) (Ruthven, 1909); Dickinson County (Ruthven, 1910).

RANA CATESBEANA Shaw.

COMMON BULLFROG.

Description: Body large and stout, head broad. Eyes large and prominent. Ear of male larger than eye. Glandular fold from eye to arm, curving behind ear. No lateral folds. Back and under surface slightly granular. Feet webbed, leaving last joint of fourth toe free. Inner sole tubercle distinct.

Ground color greenish brown, sometimes spotted with darker. Limbs spotted or barred. Under surface yellowish white, usually mottled with darker.

Measurements: Specimen No. 40913.

Length of head and body.....	.130
Length of hind limb to heel.....	.098
Width of head .....	.047

Habits and Habitat: *Rana catesbeana*, the common bullfrog, is the largest of our frogs. It does not always follow, however, that the individual *R. catesbeana* is larger than the individual *R. clamitans* or *R. pipiens*, since the size depends upon the food and environment. The bullfrog is aquatic in its habits, being found during the summer in large ponds or lakes, usually those with mud bottoms

and with deep as well as shallow water. It is a powerful swimmer, due to the fact that the toes are fully webbed and the hind limbs are long and well developed. The food consists of fish, young turtles, young water birds, frogs, small snakes and insects.



Fig. 20. Distribution of *Rana catesbeana*.
Horizontal ruling, specimens examined; vertical ruling, reports only.

The bullfrog is solitary in habit except during the breeding season and even then it sings alone and not in chorus. The song consists of a deep bass note that resembles the roaring of a bull; from this it gets the common name, the bullfrog. It is late in coming from its hibernation quarters, the eggs being laid in May or early June. Metamorphosis does not take place until the second

year and may be delayed until the third if the environment is unfavorable. This species is of great economic importance because of its value as food, the legs being considered a great delicacy by many people. The frog may be caught in the day time on a hook and line baited with a bit of red flannel. They are frequently hunted at night with lanterns, the light blinding them so that they may be easily speared by the hunter.

Distribution: East of the Rocky Mountains, including Florida and Texas. (Dickerson, 1906.)

Michigan: Specimens in the University Museum from Cheboygan, Iosco, Huron, Livingston, Washtenaw and Cass Counties. Reported from Eaton County (Clark, 1902); Eaton, Kalamazoo, Van Buren, Antrim, Montcalm, Kent, Ottawa, Barry and St. Joseph Counties (Gibbs, Notestein and Clark, 1905); *Ontonagon County (Ruthven, 1904a); Cheboygan County (Ruthven, 1911); Huron County (Ruthven, 1911a); Washtenaw County (Smith, 1879); Cass County (Thompson, 1911).

GLOSSARY.

Angle of the jaw.—Point of articulation of the two jaws.

Anus.—External opening of the intestine.

Branchiae.—External branched gills.

Caudal fin.—The tail fin.

Compressed.—Flattened from side to side.

Costal grooves.—Grooves on the sides of the body, indicating the position of the ribs.

Cranial crests.—Bony ridges extending back between the eyes.

Depressed.—Flattened from above downward.

Disks.—The enlarged and adhesive pads on the ends of the fingers and toes.

Dorsal groove.—A depression along the back.

Femur.—The upper or proximal bone of the leg.

Fronto-parietal crests.—Crests in front of, and between the eyes.

Genital openings.—External openings of the genital ducts.

Gills.—Organs for breathing the air contained in water.

Glandular.—Swollen and gland like.

Gular fold.—A transverse fold of skin across the throat.

Hibernate.—To refrain from an active condition, to remain in a torpid state over winter.

**Rana catesbeana* has been reported from Ontonagon County by Ruthven (1904a) but the specimens were later identified by Stejneger as somewhat anomalous specimens of *Rana clamitans* (Ruthven, 1906).

Lateral folds.—Gland like folds extending along the sides of the back.

Maxillary.—The bone of the upper jaw, back of the premaxillary. It forms the greater part of the upper jaw and may bear teeth.

Maxillary teeth.—Teeth borne on the maxillary bone.

Metamorphosis.—Change from the larval to the adult condition.

Metatarsal tubercles.—Tubercles on the toes.

Mucous membrane.—Membrane lining the mouth.

Nares.—Nostrils; the external openings are called external nares. the internal openings internal nares.

Palatine.—A pair of bones just behind the vomers and extending transversely across the skull.

Parasphenoid.—The large broad bone in the roof of the mouth which forms the floor of the brain case.

Parasphenoid teeth.—Teeth borne on the parasphenoid bone.

Parotid glands.—Elevated glandular bodies found back of the eye in toads.

Pectoral.—Pertaining to the shoulder or breast.

Plantar tubercles.—Tubercles on the palm.

Postorbital crests.—Bony crests extending behind the eye.

Premaxillary.—The two bones, one on either side, in front of the maxillaries. They unite to form the anterior angle of the upper jaw.

Premaxillary teeth.—Teeth borne on the premaxillary bone.

Protective coloration.—Coloration of such a character that it serves to conceal the animal in the natural surroundings.

Rudimentary.—Not well developed. Degenerate.

Scuted.—Having scutes or scales.

Segmentation.—The cleavage of the eggs which takes place after fertilization.

Sole tubercles.—Small callous like projections on the sole of the foot.

Spawning.—The act of depositing the eggs.

Sperm.—The male sex element.

Spermatophores.—Small mushroom like bodies containing the sperm, deposited in the water by the male of some species during the breeding season.

Vermiculated.—Covered with fine irregular color marks.

Vertebral.—Pertaining to the vertebrae or spinal column.

Viridescent.—Greenish.

Vomer.—A pair of bones in front of the parasphenoid and forming the floor of the olfactory capsule.

Vomero-palatine teeth.—Teeth borne on the vomerine and palatine bones.

THE REPTILES OF MICHIGAN.

BY ALEXANDER G. RUTHVEN.

INTRODUCTION.

In the opinion of the writer, the inadequateness of the available information on the reptiles of Michigan may be attributed in part to the fact that there is no available manual on the subject suitable for the use of local students. The literature consists, with few exceptions, of a few general and local lists and incidental references to Michigan specimens in general works on herpetology. Aside from their limitations as lists the more general papers are all more or less erroneous and antiquated, and the local lists at best deal with too widely separated localities to be of general interest. The other records have, of course, the disadvantage of being widely scattered. It is hoped that this report will furnish an accurate summary of our present knowledge of the subject, and also serve to encourage further work.

LITERATURE.

The publications which treat either entirely or in part of Michigan specimens are as follows:

1. Sager, Abraham. Senate Doc., State of Michigan, 1839, pp. 294-305. A list of Michigan reptiles collected by the State Geological and Natural History Survey. No localities or other data given. Copied in Senate Documents of the same year.

2. Holbrook, J. E. North American Herpetology, 1842. Gives "Michigan" in the range of several species.

3. Baird, S. F. and Girard, C. Catalogue of North American Reptiles, 1853. Specimens of *Elaphe vulpinus*, *Storeria dekayi*, *Sistrurus catenatus*, *Natrix sipedon* and *Regina leberis* listed from Michigan and two new species, *Bascanion forii* and *Nerodia agassizii*, described on the basis of Michigan material.

4. Hallowell, Edward. Proc. Acad. of Nat. Sci. Philadelphia, 1856, p. 310. A description of a specimen of *Eumeces quinquelineatus* from the neighborhood of Flint, Michigan, as a new species—*Plestiodon vittigerum*.

5. Agassiz, Louis. Contributions to the Natural History of the

United States, I, 1857. Several species of turtles recorded from Michigan.

6. Miles, Manly. A Catalogue of the Mammals, Birds, Reptiles and Molluscs of Michigan. 1st. Bien. Rept. Geol. Surv. of Mich., 1861, pp. 219-241. A list of the reptiles known to occur in the state with a few foot-note records of localities.

7. Smith, W. H. Catalogue of the Reptilia and Amphibia of Michigan, Supp. to Science News, 1879. A list of Michigan reptiles based on the specimens in the University of Michigan Museum and the private collection of the writer. No data is given but those found in the vicinity of Ann Arbor are indicated by a star.

8. Gibbs, M. Forest and Stream, XXXIX, 1892, p. 7. I have not been able to consult this article.

9. Stejneger, Leonhard. Rept. U. S. Nat. Mus., 1893, pp. 337-487. States that *Sistrurus catenatus* is common in parts of Michigan.

10. Kirsch, Philip. Bull. U. S. Fish Comm., XIV, 1895, p. 333. Several species of reptiles listed from points in lower Michigan.

11. Cope, E. D. The Crocodilians, Lizards and Snakes of North America. Rept. U. S. Nat. Mus., 1898 (1900), pp. 153-1270. Contains records of Michigan specimens of several species.

12. Gibbs, M. Herpetology of Kalamazoo County, Michigan. Wolverine Naturalist, Feb. 1900, pp. 12-13. *Crotalus horridus* (one specimen) and *Sistrurus catenatus* recorded from Kalamazoo⁴ County with notes on the habits of the latter.

13. Clark, H. L. Notes on the Reptiles and Batrachians of Eaton County, Michigan. 4th. Ann. Rept. Mich. Acad. Sci., 1902, pp. 192-194. A list of the reptiles of Eaton County, with miscellaneous notes on size, abundance, variation, etc.

14. Clark, H. L. The Water Snakes of Southern Michigan. Amer. Naturalist, XXXVII, 1903, pp. 1-23. A careful statistical study of the water snake (*N. sipedon*) on the basis of material collected in Eaton County, Mich. The writer concludes that the red-bellied specimens (*erythrogaster*) represent a distinct species. Notes on the habits of *N. sipedon* and *Regina leberis*.

15. Clark, H. L. Notes on Michigan Snakes. 5th Ann. Rept. Mich. Acad. Sci., 1903, pp. 172-174. Miscellaneous notes on *Natrix sipedon*, *Bascanion constrictor*, *Elaphe obsoletus*, *Lampropeltis dolius triangulus*, and the garter-snakes.

16. Clark, H. L. The Short-Mouthed Snake (*Eutainia brachystoma* Cope) in Southern Michigan. Proc. Biol. Soc. Wash., XVI, pp. 83-88. A discussion of the characters, variation and habits of specimens of *Thamnophis butleri* collected in Eaton county.

17. Sperry, W. L. Variation in the Common Garter Snake (*Thamnophis sirtalis*). 5th Ann. Rept. Mich. Acad. Sci., 1903, pp. 175-179. A discussion of the variation, scutellation and tail-length of specimens of *T. sirtalis* from Eaton County. Some of the specimens are referred (erroneously) to *T. sirtalis parietalis*.

18. Ruthven, Alexander G. Butler's Garter Snake. Biol. Bull., VII, 1904, pp. 289-299. In this paper the writer records *Thamnophis butleri* from several localities in southern Michigan, shows the distinctness of the form from *T. sirtalis* and that the specimens referred by Clark to *T. brachystoma* are referable to it, discusses the habits, distribution, characters, variations and affinities and gives the synonymy and a list of the known specimens.

19. Ruthven, Alexander G. Notes on the Molluscs, Reptiles and Amphibians of Ontonagon County, Michigan. 6th Ann. Rept. Mich. Acad. Sci., 1904, pp. 188-192. Records of the species collected by the writer in the Porcupine Mountains, Michigan, in 1903, with notes on their occurrence.

20. Clark, H. L. A Preliminary List of the Amphibia and Reptilia of Michigan. 7th Ann. Rept. Mich. Acad. Sci., 1905, pp. 109-110. This list, compiled with the assistance of Morris Gibbs and F. Notestein, purports to be a list of Michigan reptiles with the localities (principally counties) in which the species have been observed. Unfortunately it is based principally upon records the sources of which are not given so that, while it is quite accurate as a list of Michigan species, the careful student cannot accept the localities as reliable.

21. Notestein, F. N. The Ophidia of Michigan. 7th Ann. Rept. Mich. Acad. Sci., 1905, pp. 112-125. The writer of this paper has endeavored to give a synopsis of the reptiles of the state with keys to make possible the easy determination of specimens. In reality what he has done is to describe the species that may occur in the state without giving any state records, so that, while the paper will assist in determining Michigan specimens, it cannot be considered as a monograph on Michigan herpetology. The paper is, furthermore, marred by very numerous typographical errors which, altho it must be said not the fault of the writer, greatly impair its usefulness to the general student.

22. Whittiker, C. C. The Status of *Eutaenia brachystoma*. 7th Ann. Rept. Mich. Acad. Sci., 1905, pp. 88-92. The writer compares the published description of the type specimen of *Thamnophis brachystoma* with material of *T. butleri* and concludes that *brachystoma* is a synonym of the latter.

23. Whittiker, C. C. Variation in the Blue Racer. 7th Ann. Rept. Mich. Acad. Sci., 1905, pp. 100-102. A brief account of the natural history and a discussion of the variation in scutellation and proportionate size of extremities observed in 58 specimens of *Bascanion constrictor* from Eaton County.

24. Gibbs, Morris. Bibliography for the Amphibia and Reptilia of Michigan. 7th Ann. Rept. Mich. Acad. Sci., 1905, p. 111. A list of the papers "which directly refer to Michigan herpetology so far as known to the writer."

25. Ruthven, Alexander G. The Cold-Blooded Vertebrates of the Porcupine Mountains and Isle Royale, Michigan. Rept. Geol. Survey Mich. for 1905 (1906), pp. 107-112. Lists the species (5 snakes and 1 turtle) known to occur in the northern peninsula of Michigan with notes on the habits and habitats. The list is based principally on specimens secured by the expeditions of the University of Michigan Museum and upon the field notes of the writer.

26. Hankinson, T. L. A Biological Survey of Walnut Lake, Michigan. Rept. Mich. Geol. Surv., 1907 (1908), pp. 153-288. Contains a list of eight species of reptiles from the vicinity of Walnut Lake, Oakland County.

27. Ruthven, Alexander G. The Cold-Blooded Vertebrates of Isle Royale. Rept. Geol. Surv. Mich. for 1908 (1909), pp. 329-333. A summary of the herpetology of Isle Royale based principally upon the data secured by the University of Michigan Museum expeditions.

28. Ruthven, Alexander G. Variations and Genetic Relationships of the Garter-Snakes. Bull. U. S. Nat. Mus., 61, 1908. Contains Michigan records of *Thamnophis butleri*, *T. sirtalis*, and *T. sauritus* and notes on the habits of these species.

29. Ruthven, Alexander G. Notes on Michigan Reptiles and Amphibians. 11th Ann. Rept. Mich. Acad. Sci., 1909, pp. 116-117. The writer shows that the Michigan specimens of wood-frog are referable to the species *cantabrigensis*, extends the northward range of *Thamnophis butleri* to Huron County, summarizes the distribution of *Heterodon platyrhinus* and *Elaphe vulpinus* in the state, giving new records, and shows that Porcupine Mountain specimens of *Chrysemys* are *C. bellii*.

30. Ruthven, Alexander G. Notes on Michigan Reptiles and Amphibians, II. 12th Ann. Rept. Mich. Acad. Sci., 1910, p. 59. Records *Rana septentrionalis*, *Elaphe vulpinus* and *Chrysemys bellii* from Dickinson County.

31. Ruthven, Alexander G. Notes on Michigan Reptiles and Amphibians, III. 13th Ann. Rept. Mich. Acad. of Sci., 1911, pp. 114-115. Contains a summary of the distribution of *Diadophis*

punctata and a list of the species known from Cheboygan County.

32. Ruthven, Alexander G. Amphibians and Reptiles in A Biological Survey of the Sand Dune Region on the South Shore of Saginaw Bay, Michigan. Mich. Geol. and Biol. Surv., Pub. 4, Biol. Ser. 2, 1911, pp. 257-272. A discussion of the reptile-amphibian fauna of the northern part of Huron County; fifteen species of reptiles recorded.

33. Thompson, Crystal. Notes on the Amphibians and Reptiles of Cass County, Michigan. 13th Ann. Rept. Mich. Acad. Sci., 1911, pp. 105-107. Records thirteen species of reptiles from Cass County.

METHODS OF STUDY.

The reptiles are a group which, in the opinion of the writer, has been much neglected by students of natural history. The result of this is shown by the small amount of material on habits and local distribution that has accumulated. Much of this neglect of a very interesting group is due to the wide spread aversion to reptiles, particularly to lizards and snakes. The truth is that most of this aversion is acquired and can be more or less easily overcome. It is due in no small part to the absurd stories that still pass current in the periodicals. We venture to say that if the statement were published in the daily papers that there is in Michigan but one poisonous snake (rattle snake), that the largest snakes we have are the blue racer, fox snake and pilot snake, which seldom attain a length of over six feet, that the breath of the "blowing adder" is not poisonous, that snakes do not sting with their tongues nor swallow their young, it would call forth numerous protests and snake stories by "eye-witnesses" exactly to the contrary.

It seems absurd to one acquainted with these interesting animals to have to deny such stories. Our reptiles are only dangerous as they are poisonous, and the poison is only conveyed by large fangs and only possessed by one species—the rattle snake. On the other hand there are few groups that will better repay a study of the habits, both for the reason that a knowledge of the natural history of the forms is of value in the study of their distribution and relationships and because so little is known on the subject. The work on the natural history and distribution of the forms must be preceded by a determination of the species, but fortunately the latter is not difficult for our forms are few and in general well defined. The classification is based on structural characters, of course, but the external characters are sufficient for the identification of Michi-

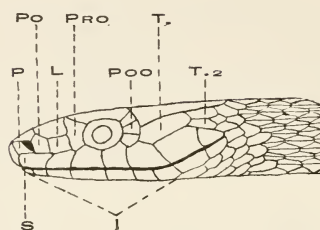


Fig. 21. Head of snake, side view, to show arrangement of scales.

P, prenasal; Po, postnasal; L, loreal; Pro, preocular; Poo, postoculars; T, first temporal; T₂, second temporals; S, superior labials; I, inferior labials.

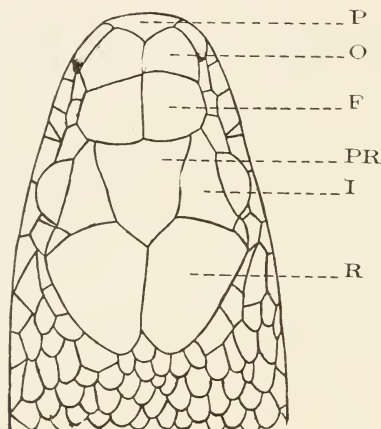


Fig. 22. Head of snake, side view, to show arrangement of scales.

P, rostral; O, internasals; F, prefrontals; PR, frontal; I, supraocular; R, parietals.

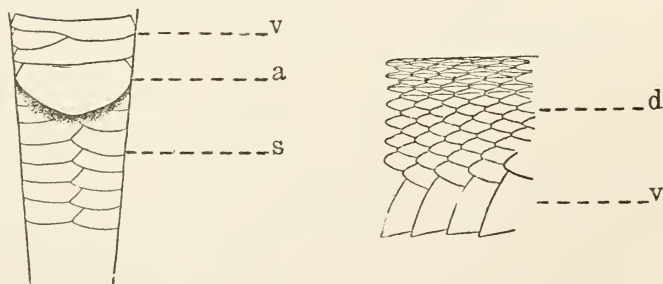


Fig. 23. Scales on the body of a snake. (After Cope.)

v, ventrals; a, anal plate; s, subcaudals, d, dorsals.

gan forms and have alone been used in this report. The anatomy is dealt with in most of the standard text-books on zoology.

In the identification of species the following characters (compare figures) should be noted:

Snakes.

1. Form of body and general size.
2. Arrangement of scales on the top, sides and under surface of head (Figs. 21, 22).
3. Arrangement of scales on dorsal surface of body and the number of rows at various places, i. e., between the head and anus (Fig. 23).
4. Whether the dorsal scales are smooth or keeled.
5. Number of large plates on the ventral surface between the head and tail (Fig. 23).
6. Character of anal plate, i. e., whether single or divided (Fig. 23).
7. Character of scales on the ventral surface of the tail, i. e., whether in a single or double series.
8. Coloration.

Turtles.

1. General size.
2. Shape of upper (carapace) and lower (plastron) shell.
3. Surface of shell, i. e., whether covered with horny plates or by a soft skin.
4. Size of plastron as compared with opening of carapace, also form of the bridge between the plastron and carapace (Figs. 25-27), and whether or not the plastron is divided by a transverse hinge.
5. Number and arrangement of plates in the different series on carapace and plastron (Figs. 24, 25).
6. Character of anterior end of upper jaw, i. e., whether notched or projected into beak.
7. Character of biting and grinding surfaces of jaws, particularly as regards width of grinding surfaces.
8. Extent of web on digits.
9. Coloration.

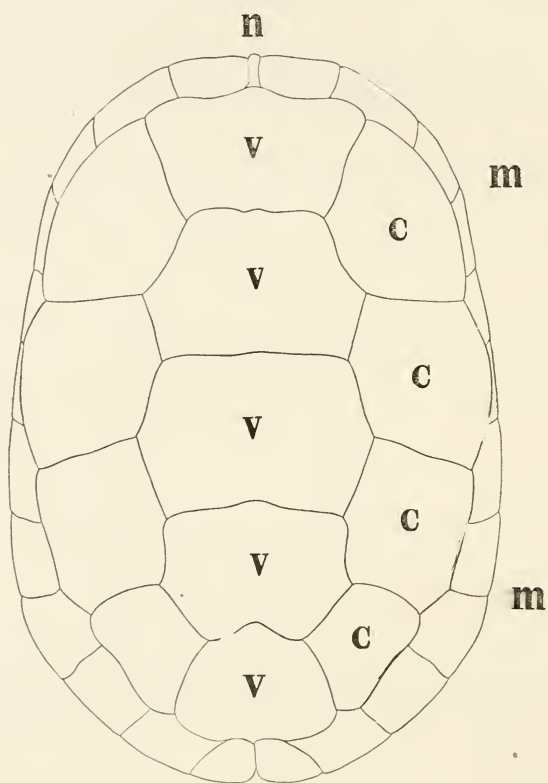


Fig. 24. Carapace of *Emydoidea blandingii*, to show position of plates.
v, vertebrals; C, costals; N, nuchal; M, marginals.

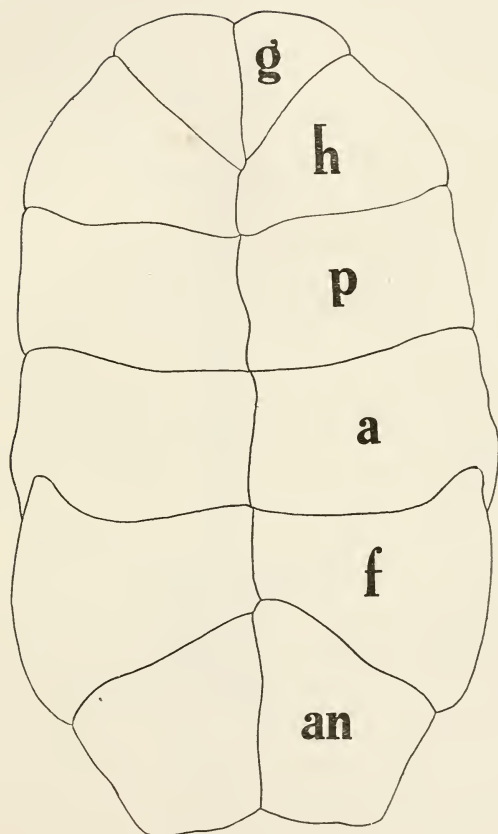


Fig. 25. Plastron of *Emydoidea blandingii*, to show position of plates.
g, gulars; h, humerals; p, pectorals; a, abdominals; f, femorals; an, anals.

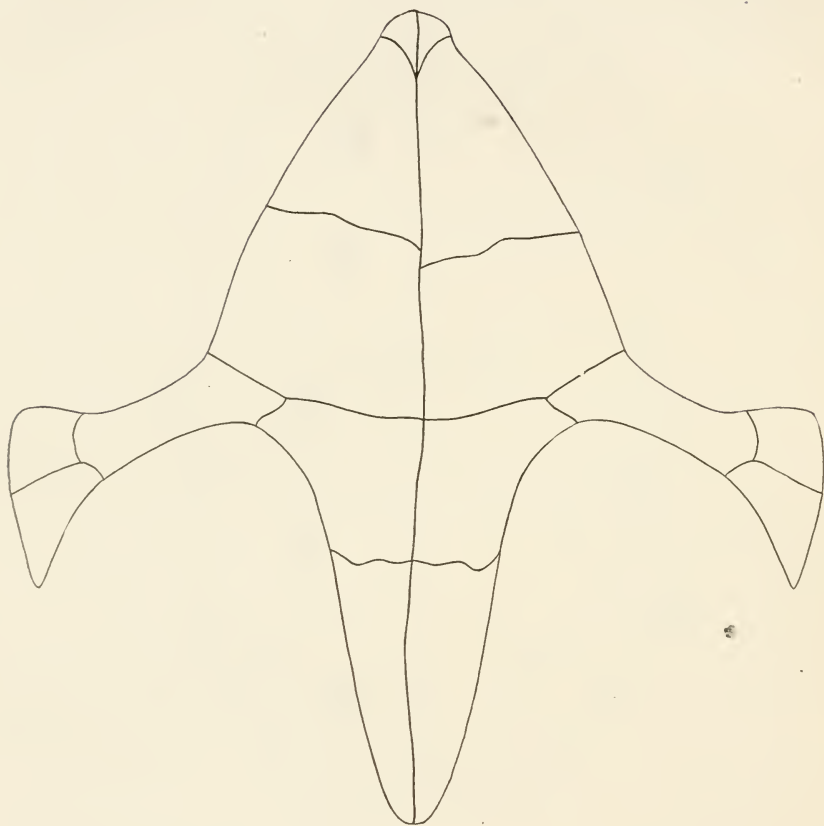


Fig. 26. Plastron of *Chelydra serpentina*.

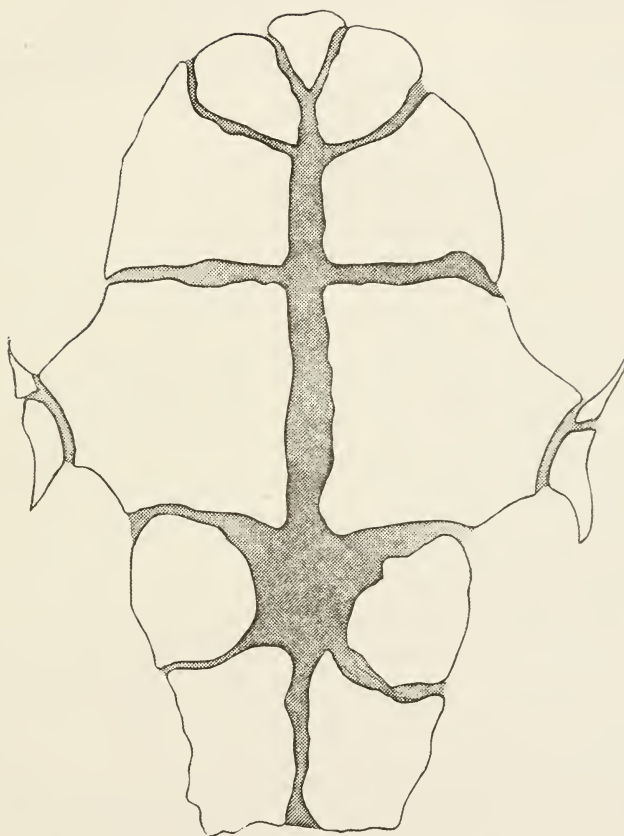


Fig. 27. Plastron of *Kinosternon odoratum*.

The above outlines may very easily be elaborated by teachers into laboratory directions. We would suggest, first, the identification of specimens accompanied by notes on individual and sexual variation; second, observations on the habits of captive specimens; third, field study of habits and habitats; fourth, the preparation of tables to show in a comparative way the characters and habits of the different species studied; and, fifth, a summary of the ways in which the characters are evidently adaptive.

METHODS OF COLLECTING AND PRESERVING SPECIMENS.

Collecting: As the rattlesnake is the only poisonous serpent in Michigan, the collecting of reptiles may be done with safety by any one well enough acquainted with this species to distinguish it. With the exception of the rattlesnake, all of the Michigan snakes may be grasped in the hands, with no more dangerous results than would occur in the case of a bird the size of a robin. It is always most convenient to grasp the animal by the neck, however, as it is then more easily handled and examined. Cloth bags about the size of those used to hold corn meal or a little smaller should be carried in the field. The snakes, turtles and lizards may be dropped into these and carried back alive to the laboratory or work room.

Lizards may frequently be grasped in the hand and always with impunity, but if seized by the tail there is great probability that this alone will be secured, as the animals part with this member readily. The most efficient way to capture them alive is to cautiously slip over their heads a noose made of horse hair, thread or fine wire and placed on the end of a stick. Turtles may be readily picked up by the carapace (upper shell), it only being necessary to avoid the jaws of the larger ones.

Collectors who wish to obtain series of specimens in a short time will find it more advantageous to shoot the larger snakes, lizards, rattlesnakes, and those forms that frequent the margins of lakes, ponds and streams. In our collecting we find it very convenient to carry a small, double-barreled shot-gun (44 gauge, which takes a 40-85 brass rifle shell, or a 28 gauge) or a 22 caliber target pistol bored smooth and shooting the .22 shot shell. We load the shotgun shells with a small charge of black powder, and dust shot (No. 14). Charges of these sizes do not usually greatly injure the specimen.

Cages. Very efficient and cheap cages for snakes and lizards may

be made by placing a sliding pane of glass in the top of a shallow, light wooden box. The pane of glass serves as a window through which the animals may be observed, and also as a door through which they may be taken in or out or food introduced. It is always best to have the glass on top so that it can be opened temporarily without danger of the inmates escaping, and holes should be bored thru the side of the box and covered with screen, so as to provide air. Water in a small dish fastened to the bottom of the cage should always be present.

Turtles (except the box turtle) should be placed in a metal tank in shallow water with stones upon which they may climb. No covering is necessary if the sides are reasonably high or the edges turned inward. The box turtle should have a dry cage.

Specimens should be fed shortly after being placed in the cage, and rather regularly thereafter, for if they can be induced to eat there will be no trouble in keeping them alive. Water should be kept in the cages at all times.

Preservation of Specimens: The animals captured alive should be killed by immersing, while still in the bags, in a pail of water. When dead they should be removed from the bags and either injected freely (snakes and lizards along the belly, turtles behind the fore legs and in front of the hind legs) with 4% formalin, by means of a hypodermic syringe, or if a syringe is not available, slit open. Several slits about an inch or two inches long (according to the size of the specimen) should be made along the ventral surface of the snakes (none on the tail). One short slit will serve for the lizards, and the turtles may be slit open in front of the hind legs and behind the fore legs. The formalin solution may be made by adding 24 parts of water to 1 part of the 40% solution of formalin sold as pure, and the results are much better if the better grades of formalin (i. e., Shering's) are used. The specimens should then be placed in pans (do not crowd) and covered with the same solution. When well hardened they may be transferred to glass jars or covered crocks and covered with 75% alcohol. In the case of large specimens of turtles the shell only need be saved.

A label should be attached to each specimen, giving the locality, date of collection, collector and habitat, but if a notebook or catalog is kept, the specimen may be given a serial number and the data kept in the notebook or catalog opposite the corresponding number. The label should be tied about the body in the case of lizards and snakes (about one-third of the way back from the head in snakes and just behind the forelegs in lizards) and on the left hind leg in

turtles. Only in the case of the latter should the string be tied so tightly as to crease the skin.

DESCRIPTIONS OF MICHIGAN REPTILES.

CLASS REPTILIA.

The living reptiles are cold-blooded vertebrates that breathe by means of lungs and usually have a covering of horny epidermal scales; the latter sometimes supported by bony dermal plates. The only Michigan species that does not have the body covered with scales is the soft-shelled turtle (*Platypeltis spinifera*). In external form the body is elongate and limbless (snakes), somewhat elongate and usually quadrupedal but occasionally apodal (lizards and crocodilians), cuirassed and quadrupedal (turtles). The quadrupedal lizards are frequently confused with salamanders, but the quadrupedal salamanders (which alone occur in Michigan) always lack the bony or horny covering characteristic of reptiles, the skin being thin and moist. The apodal lizards are frequently confused with snakes, but the only apodal lizard in northeastern North America, the so-called glass snake (*Ophiosaurus ventralis*), may always be distinguished from snakes by the presence of eyelids and external ears. This lizard has never been recorded from Michigan, although it is said to occur in Wisconsin. Numerous morphological characters other than those given characterize the Class Reptilia and may be found by referring to any vertebrate zoology.

Distribution of the Class Reptilia in Michigan.—The distribution of each species is discussed in detail with its description. In general the reptile fauna of the state is characterized by the small number of forms. This is due in large part to the northern latitude of the region, as the reptiles are primarily a tropical group. The influence of temperature upon the distribution is also shown within the state. It is true in both orders that as one goes northward from the southern boundary of the state the number of species gradually decreases. Thus it may be seen by an examination of the maps that twenty-five or all but one of the species in our fauna have been recorded from the two southernmost tiers of counties while only six have thus far been found in the northern peninsula, and only one occurs there and not in the southern peninsula. It must be admitted, of course, that our information on the intrastate distribution of the species is far from complete, but enough has been learned to make it quite evident that further work will not overthrow this conclusion.

Another general fact of distribution may be pointed out, namely, that there is a western element in the fauna of the northern peninsula. This is at present only shown by the occurrence of *Chrysemys bellii* in that region, but it is in harmony with what has been shown to occur in other groups.

KEYS TO THE ORDERS AND SUBORDERS OF MICHIGAN REPTILES.*

- a¹. Body elongate and covered with small scales. Anus a cross-slit. Order Squamata (Lizards and Snakes).
 - b¹. Limbs present. Eyelids movable. An external ear opening. Suborder Sauria (Lizards), p. 77.
 - b². Limbs absent. No external ear opening or movable eyelids. Suborder Serpentes (Snakes), p. 81.
- a². Body short and broad and enclosed between two (upper and lower) shields. Limbs present. Anus rounded or a longitudinal slit. Order Testudinata (Turtles), p. 128.

ORDER SQUAMATA—SUBORDER SAURIA (LIZARDS).

Description: As indicated by the key, the lizards of Michigan may always be known from the other reptiles by the combination of characters, presence of small scales over the body and of four limbs. As already said, they are frequently confused with the salamanders but may always be told from them by the fact that the skin is never smooth and moist.

Key to the Genera and Species of Michigan Lizards.

- a¹. Body covered above with fine tubercular scales. Tongue deeply bifid. *Cnemidophorus sexlineatus* (L.)†
- a². Body covered above with rather large, imbricated scales. Tongue slightly notched. *Eumeces quinquilineatus* (L.).

EUMECES QUINQUILINEATUS (Linnaeus).

BLUE-TAILED SKINK.

(Pl. VIII.)

Plestiodon vittigerum,‡ Hallowell, 1856, 310.

Eumeces fasciatus, Smith, 1879, 6. Clark, 1905, 110.

Eumeces quinquilineatus, Cope, 1900, 637-638. Ruthven, 1911a, 263-264.

*It is hardly necessary to say that the keys in this paper are highly artificial. They are designed only to to furnish an easy and efficient means of identifying the species.

†The genus *Cnemidophorus* has not been recorded from this state, so it will not be considered further in this work. *C. sexlineatus* occurs in northern Indiana, however, and is to be looked for in southwestern Michigan in the sand dunes along Lake Michigan.

‡The synonymy given under each species includes only papers that refer to Michigan specimens.

Description: Four well developed limbs. Body covered with rather large, imbricated, smooth scales. Tongue flat, moderately long, free, slightly notched in front, and covered with overlapping scale-like papillae. Head with symmetrically arranged plates.

The color of the blue-tailed skink varies greatly with age. The color of medium sized individuals is, above dark olive with five bluish or greenish white, or yellowish stripes (one median and two lateral on either side); under surface pale; tail usually bright blue. Old specimens are reddish olive with the stripes obscure (females) or wanting (males) and the head coppery red. Young specimens are jet-black with bright yellow stripes.

Habits and Habitat: This skink is distinctly diurnal, being most active on warm, bright days in summer. Little is known of its habitat preferences in Michigan, but in other regions it is usually found in wooded areas, being seen frequently in piles of brush or fallen logs. It is very agile, and, like most of the smaller lizards, its tail breaks easily so that if seized by this appendage the animal easily escapes by parting with the captured portion. The following account of the habits of specimens observed in the sand region of Huron County has been given by the writer (Ruthven, 1911a, 263-264).

"In the woods of the sand region it was found on the dry ridges, under and in decaying logs, where it fed on the insects that frequent such situations. It was, however, much more common than elsewhere under the drift logs on the fossil beaches, and also on the middle beach on the present shore, at the extremity of Sand Point. The logs strewn along the fossil beaches were in an advanced stage of decay, and usually consisted of an outer shell of better preserved wood covering a mass of decomposed debris, the decomposition taking place most rapidly next to the ground. This apparently furnished a very favorable habitat for these lizards, great numbers of which were found in the decomposed material when the outer shell of the log had been removed. (Pl. VIII.)

"The eggs were laid in the same material, the female generally scooping out a small hollow in the bottom of which the eggs were partially buried in the debris. Both in the woods and on the beaches nests were occasionally found in the sand beneath a log or board where there was only a small amount of decaying wood, but in every case there was at least a small amount. Females taken on June 19 were pregnant, containing large eggs apparently nearly ready to be laid. The first sets observed were on July 2, and on and after this date nests of eggs were found in numbers. Every-

thing went to show that the eggs are mostly laid about the first of July. None were observed before this date, and those collected on July 2 were all clean—they usually become much stained from the decaying wood after being in the nest for some time. The number of eggs in the set was counted in eight instances and were as follows: 6, 6, 8, 8, 9, 11, 13, 14. An examination of the pregnant females shows that the number in each set varies with the size (age?) of the female, the smaller ones having 6 to 8 eggs, the larger ones 9 to 14. It is interesting to compare this with the statement of Ditmars (1907, 202) that he found the normal numbers to be 3 or 4, and that of Strecker (1908, 169) 'the several sets that I have examined were all of 8 eggs each.'

"It was interesting to observe the behavior of the female when with her eggs. As is well known she remains with them until they are hatched, but for what purpose is not evident. We usually found them coiled about the eggs, but sometimes they simply lay beside them. In any case there seemed to be no attempt to come in immediate contact with the eggs, and indeed this would have been impossible in most instances, as the eggs themselves were not even in contact with each other, being somewhat scattered about in the decaying debris. However, there seemed to be a disposition on the part of the female to keep her set together; several times I saw a female leave her position and crawl about the eggs, and when she encountered one which I had displaced, lick it and then nose it back with the others. If care was taken in removing the outer shell of the log to expose the nest, the female would remain with the eggs, only burying herself deeper in the loose debris when her head was exposed to the light.

"The first young of the year were observed on July 31, when a female was found under a small log on a sand beach, coiled about a nest of 8 eggs from which the young were emerging."

Ditmars (1907, 202) states that the "food consists largely of insects, but well-grown specimens will feed upon the eggs of birds, or newly born wood mice, often discovered by the lizard as it investigates the crevices of fallen trees." Surface (1908a, 251) records the larva of a Geometrid moth in the stomach of one specimen. Cope (1900, 638) states that a captive specimen gorged itself with wood lice (*Oniscus*).

Range: The blue-tailed skink was probably not uncommon in the southern part of lower Michigan before the timber was removed. Whether or not it was of general distribution will probably never be known; it is now apparently very rare over much of this region.

It has been reported from Genesee County (Hallowell, 1856, 310; Cope, 1900, 637), Ann Arbor (Smith, 1879, 6), Barry, Kalamazoo, Kent, Montcalm, Ottawa, St. Joseph and Van Buren Counties (Clark, 1905, 110). It was observed to be quite common in the

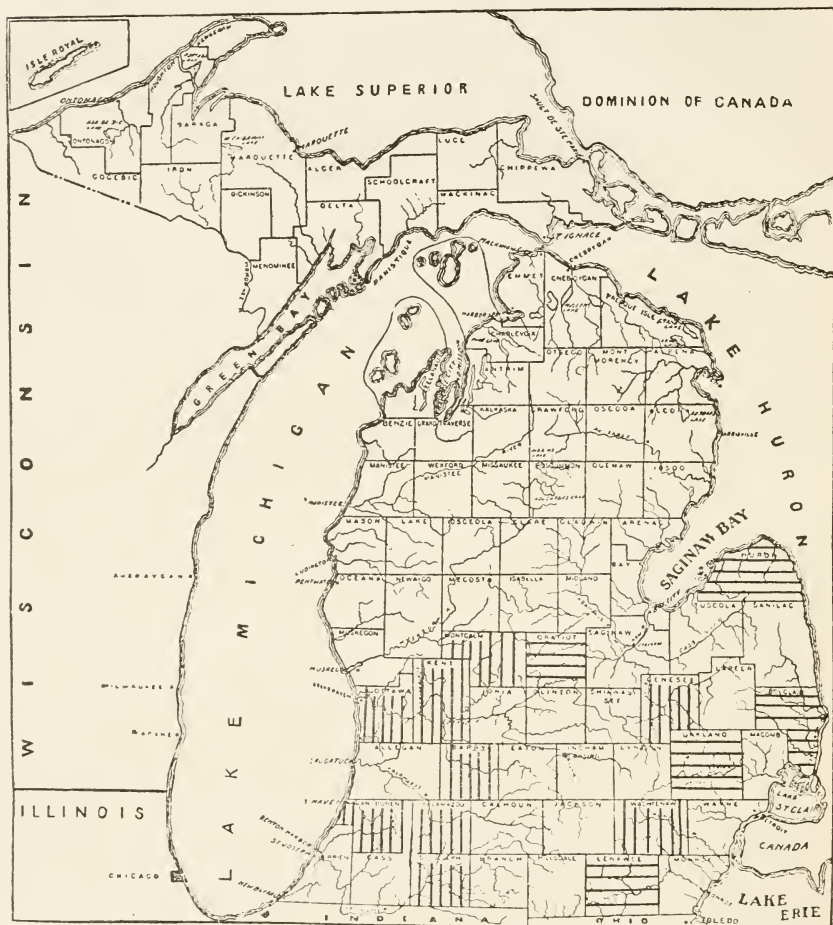


Fig. 28. Distribution of *Eumeces quinquilineatus*.
Horizontal ruling, specimens examined; vertical ruling, reports only.

sand region along the south shore of Saginaw Bay, between Bayport and Port Crescent in 1908 (Ruthven, 1911a, 263-264), and specimens have recently been received from St. Clair and Oakland Counties. Three specimens (one accompanied by eggs), collected by W. J. Beal in Lenawee County (no date), are in the University of Michigan collection, and we have examined a specimen taken at Alma,

Gratiot County. These are the only specimens from Michigan that the writer has seen. There is a record in the University of Michigan Museum catalog of a specimen (No. 369) collected by E. W. McGraw at Ann Arbor, but the specimen cannot now be found.

ORDER SQUAMATA—SUBORDER SERPENTES (THE SNAKES).

Description: As previously stated the Michigan snakes may be distinguished from the other members of the class in the state by the absence of limbs, external ear openings, and movable eyelids. The body is elongate and covered with scales. The scalation is as follows: small imbricated smooth or keeled scales forming longitudinal and diagonally transverse rows on the dorsal surface of the body and tail. A single series of large transverse and imbricated scutes on the ventral surface of the body with a somewhat larger single or divided plate (anal) just in front of the anus. A single or double row of imbricated scutes on the ventral surface of the tail. Large symmetrically arranged plates on the head.

Key to the Snakes of Michigan.

- a¹. No pit between the eye and nostril. Tail not terminating in a rattle.
 - b¹. Anal plate divided.
 - c¹. Dorsal scales keeled (occasionally but faintly).
 - d¹. Loreal plate absent, *Storeria*.
 - e¹. Oculars 1-2.....*S. dekayi*, p. 83.
 - e¹. Oculars 2-2.....*S. occipitomaculata*, p. 85.
 - d². Loreal plate present.
 - e¹. Rostral plate greatly developed and protruding.....*Heterodon platyrhinus*, p. 87.
 - e². Rostral plate normal, i. e., flattened over the end of the muzzle.
 - f¹. First 3-5 rows of dorsal scales smooth, the rest weakly keeled, *Elaphe*.
 - g¹. Color above black or with obscure blotches*E. obsoletus*, p. 90.
 - g². Color above yellowish to light brown with prominent dark brown blotches.....*E. vulpinus*, p. 93.
 - f². Scales of all of the dorsal rows (except often the first) strongly keeled.

- g¹. Dorsal scale rows never less than 21-23-21-19-17. *Natrix sipedon*, p. 95.
- g². Dorsal scale rows never more than 19-17.
- h¹ A light lateral stripe on the 1st and 2nd rows, no dorsal blotches. *Regina leberis*, p. 98.
- h². No light lateral stripes, dorsal blotches present
Clonophis kirtlandi, p. 100.
- c². Dorsal scales not keeled.
- d¹. A single nasal plate pierced by the nostril.
.....*Liopeltis vernalis*, p. 102.
- d². Two nasal plates, the nostril between them.
- e¹. A yellow collar. Uniformly blackish above,
.....*Diadophis punctatus*, p. 104.
- e². No yellow collar, adults uniformly green to blackish above, young spotted.....
.....*Bascanion constrictor*, p. 107.
- b². Anal plate entire.
- c¹. Dorsal scales smooth. Dorsal blotches present. No stripes....*Lampropeltis doloiatus triangulus*, p. 110.
- c². Dorsal scales keeled, a dorsal and two lateral (one on either side), light stripes.....*Thamnophis*.
- d¹. Tail generally more than .27 of the total length,
.....*Thamnophis sauritus*, p. 113.
- d². Tail generally less than .27 of the total length.
- e¹. Lateral stripe on the 2nd and 3rd rows.
Labials generally 7/10.....
.....*Thamnophis sirtalis*, p. 119.
- e². Lateral stripe on the 2nd, 3rd, 4th rows anteriorly. Labials generally 6/8.....
.....*Thamnophis butleri*, p. 116.
- a². A pit between the eyes and nostril. Tail (in all but very young individuals) terminating in a rattle.....
.....*Sistrurus catenatus*, p. 124.

STORERIA DEKAYI (Holbrook).

DEKAY SNAKE.

Tropidonotus dekayi, Holbrook, 1842, IV, 54.

Storeria dekayi, Smith, 1879, 7. Notestein, 1905, 114. Clark, 1902, 194; 1905, 109. Baird and Girard, 1853, 135-136. Miles, 1861, 233. Cope, 1900, 1002-1003. Ruthven, 1911a, 266-267.

Description: A small snake seldom attaining a length of more than a foot. Body tapering toward the neck and tail. Head small but distinct. Cephalic plates normal; rostral normal. Sides of head rather high. Loreal absent, being fused with the posterior nasal; nostril situated laterally.

Dorsal scale rows, except very rarely, 17 throughout the entire length of the body. Supralabials 7; infralabials 7, very rarely 8 or 9. Oculars generally 1-2; rarely the postoculars are 3 in number, and occasionally fused into one scale, preoculars very rarely 2. Ventrals 120-137, subcaudals 44-57, anal plate divided.

The ground color above varying from dark chestnut or dark slate to pale brownish yellow, the lighter shades most common. On the vertebral line (occupying the median three and the halves of the adjacent rows) a pale yellow or greenish band, which is generally more distinct in the specimens in which the ground color is light. This band margined on either side by a darker shade of the ground color (in individuals light enough to show it), and by a row of more or less prominent black spots that may be distinct and encroach on the pale band even to the extent of fusing across it or may be so small as to be only indicated or entirely absent. The dorsal row is one of three of alternating spots that may be present on either side, all of these usually being absent or only indicated on the scales, except more often on the anterior part of the body. On the neck the spots are fused into a transverse spot on either side, these being irregular in shape and varying in size. Top of head usually dark brownish yellow, densely speckled with black. A heavy blotch of black pigment below the eye, and frequently a black bar crossing the posterior part of the first temporal and the upper and lower labials. Other head markings variable. Belly pale, with a row of very small spots on either side (one on each end of a scute) that are frequently absent and often irregular (several small ones on each scute). Newly born individuals are said to be dark gray or black above, with a ring of grayish-white around the neck. "Their dark hue changes rapidly and during the warm months suc-

ceeding their first hibernation they acquire the brown of the adult form" (Ditmars, 1907, 267).

Habits and Habitat: *S. dekayi* is rather interesting in that owing to its small size, sober colors and retiring habits it is not

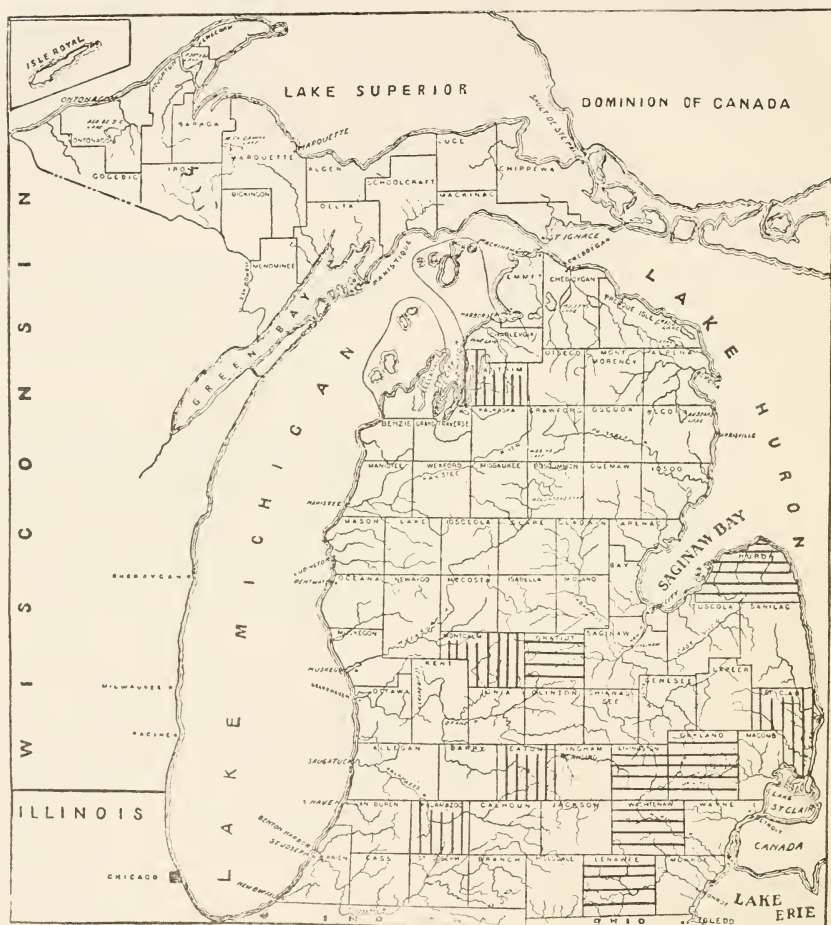


Fig. 29. Distribution of *Storeria dekayi*.
Horizontal ruling, specimens examined; vertical ruling, reports only.

exterminated by civilization, but is able to live within the limits of towns, where it is frequently found on the sidewalks, in vacant lots, etc. It seems to prefer dry woods, and probably remains in concealment most of the time as does its ally the red-bellied snake.

Surface (1906, 139) records the following items of food in the stomachs of four Pennsylvania specimens: "Earthworms in one;

slugs in three; undetermined snails in two; and undetermined insect larvae in two." Atkinson (1901, 148) states that "The stomachs of several specimens contained earthworms and beetles." Holbrook (1842, IV, 54) states that it feeds on "various insects."

Range: The species has been reported from; Grosse Isle (Baird and Girard, 1853, 135, 136; Cope, 1900, 1002), Michigan (Miles, 1861, 233; Holbrook, 1842, IV, 54), Ann Arbor (Smith, 1879, 7), Port Huron (Cope, 1900, 1003), Eaton County (Clark, 1902, 194), Ann Arbor, Olivet, and Antrim, Kalamazoo and Montcalm Counties (Clark, 1905, 109), sand region of Huron County, from Sand Point to Port Austin (Ruthven, 1911a, 266-267). Specimens from the following localities have been examined: Ann Arbor, Portage Lake, Pittsfield, Ypsilanti, Delhi, Washtenaw County, Iosco, Livingston County, Pontiac and Orchard Lake, Oakland County, Port Huron, St. Clair County, Lenawee County, sand region from Sand Point to Port Austin, Huron County, and Alma, Gratiot County.

STORERIA OCCIPITOMACULATA (Storer).

RED-BELLIED SNAKE.

Storeria occipitomaculata, Smith, 1879, 7. Clark, 1905, 109. Note-stein, 1905, 114. Ruthven, 1904a, 189-191; 1906, 110; 1909, 332; 1911a, 267; Miles, 1861, 233.

Description: A small snake attaining a length of about ten inches. Head small. Muzzle short. Cephalic plates normal. Rostral normal. Sides of head high. First temporal large, those in the second row tending to fuse into a single plate. Loreal fused with posterior nasal. Nostril lateral.

Dorsal scales in 15 rows throughout the length of the body. Supralabials usually 6, rarely 5; infralabials usually 7, occasionally 6, rarely 5 or 8. Oculars generally 2-2, rarely 3 preoculars or 1 or 3 postoculars. Ventrals 115-127; subcaudals 39-48. Anal plate divided.

Color above variable; usually a chestnut-brown, it may be light or dark gray or nearly black. A paler vertebral band margined on either side by a row of black spots or a dark chestnut band usually, but not always, present. First row of scales occasionally dark chestnut or nearly black, so that four dark bands are frequently present. Belly margined on either side by a band of gray speckled with black, the median portion red. Three (a dorsal and two lateral) yellow spots just behind the head, frequently obscure. Young when born uniformly very dark brown or black above, the nuchal spots conspicuous and the belly pink.

Habits and Habitat: The little red-bellied snake is mostly confined to woodland areas, and is very secretive, generally being found under loose stones, logs, etc. It is a very amiable little snake, and in captivity soon learns to take food from the fingers. Its food is

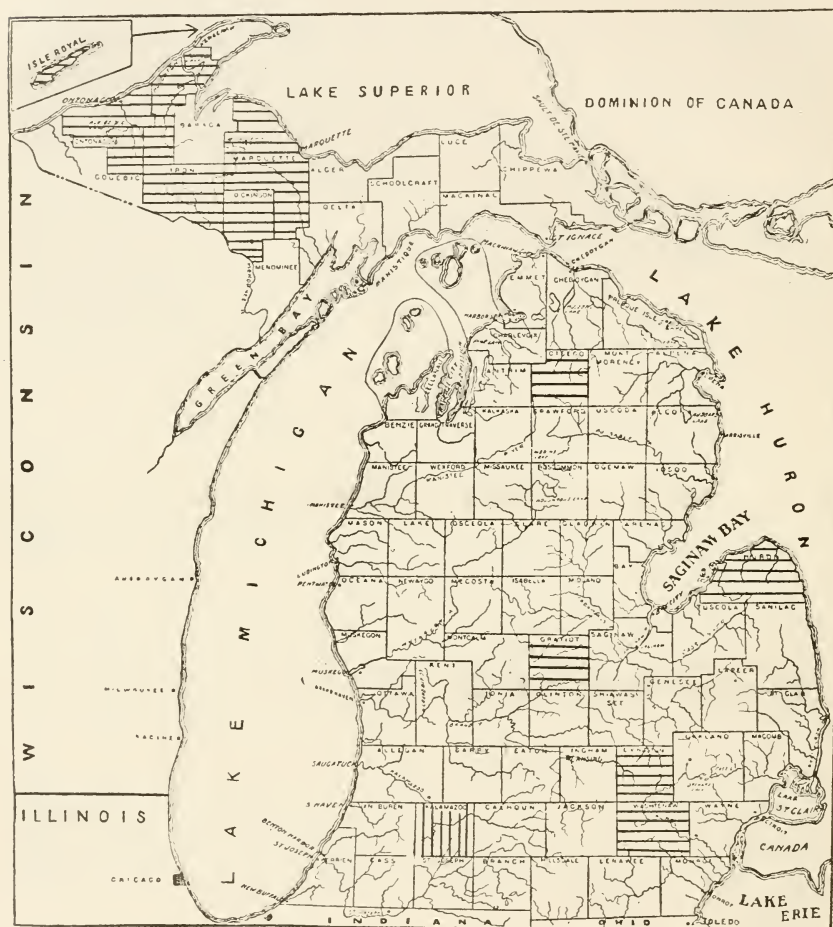


Fig. 30. Distribution of *Storeria occipitomaculata*.
Horizontal ruling, specimens examined; vertical ruling, reports only.

said to consist of earthworms (Ditmars, 1907, 270), slugs (Ditmars, 1907, 270, Hay, 1892a, 498, Surface, 1906, 137-138), beetle larvae (Ditmars, 1907, 270), insects (Morse, 1904, 133).

The young are born alive and appear in small broods of from five to thirteen, the earliest date recorded being August 18 (Ditmars, 1907, 270) for a New York specimen, and the latest date September

26 (Ruthven, 1906, 111) for an Isle Royale, Michigan, specimen.

Range: The species has been reported from: Michigan (Miles, 1861, 233), Ann Arbor (Smith, 1879, 7), Porcupine Mountains, Ontonagon County (Ruthven, 1904a, 189, 191), Isle Royale, Porcupine Mountains and Kalamazoo County (Clark, 1905, 109), Porcupine Mountains, Iron County, Marquette and Isle Royale (Ruthven, 1906, 110, 111), Isle Royale (Ruthven, 1909, 332), Sand Point, Huron County (Ruthven, 1911a, 267). The writer has seen specimens from the following localities: Ann Arbor, Washtenaw County, Iron River and Crystal Falls, Iron County, Iron Mountain and Brown Lake, Dickinson County, Isle Royale, Keweenaw County, Porcupine Mountains, Ontonagon County, Marquette, Marquette County, Plainfield, Livingston County, Sand Point, Huron County, Hancock, Houghton County, Alma, Gratiot County and Dr. F. N. Notestein informs the writer that he saw it in Otsego County in 1911.

HETERODON PLATYRHINUS Latreille.

HOG-NOSED SNAKE.

(Pl. IX b.)

Coluber heterodon, Sager, 1839, 302.

Heterodon platyrhinus, Smith, 1879, 6. Clark, 1905, 110. Notestein, 1905, 118. Ruthven, 1909a, 117; 1911a, 265. Thompson, 1911, 107.

Heterodon platyrhinus niger, Smith, 1879, 6.

Description: A snake of robust build occasionally attaining the length of three feet, but usually about twenty-eight inches. Head short and rather broad. The rostral plate greatly developed and protruded upward and forward, projecting from the muzzle as the apex of a triangular pyramid; the anterior face broad and flat, the laterals slightly concave so that the lateral and dorsal edges are projecting. Internasals entirely, and prefrontals partially, separated by a narrow and elongated plate (azygous) having the form of an irregular pentagon whose sides are parallel. The azygous with more or less of a median keel (continuing from the dorsal edge of the rostral). Two large temporal scales bordering the last three supralabials and separated from the temporals by two or three rows of smaller scales. A single loreal, and two nasal plates, the nostril valvular and situated entirely in the postnasal. A single and continuous series of small plates (9, 10, 11, or 12 in number) bordering the eye on the anterior, posterior and inferior sides, occupying the place of the usual preoculars and postoculars, and separating the orbit from the supralabials.

Dorsal scale rows usually 25-23-21-19, keeled and with two pits; supralabials usually 8; infralabials 9, 10, or 11; ventrals 120-137; subcaudals 33-48; anal divided.

The ground color of the back varies from gray or yellow to red,

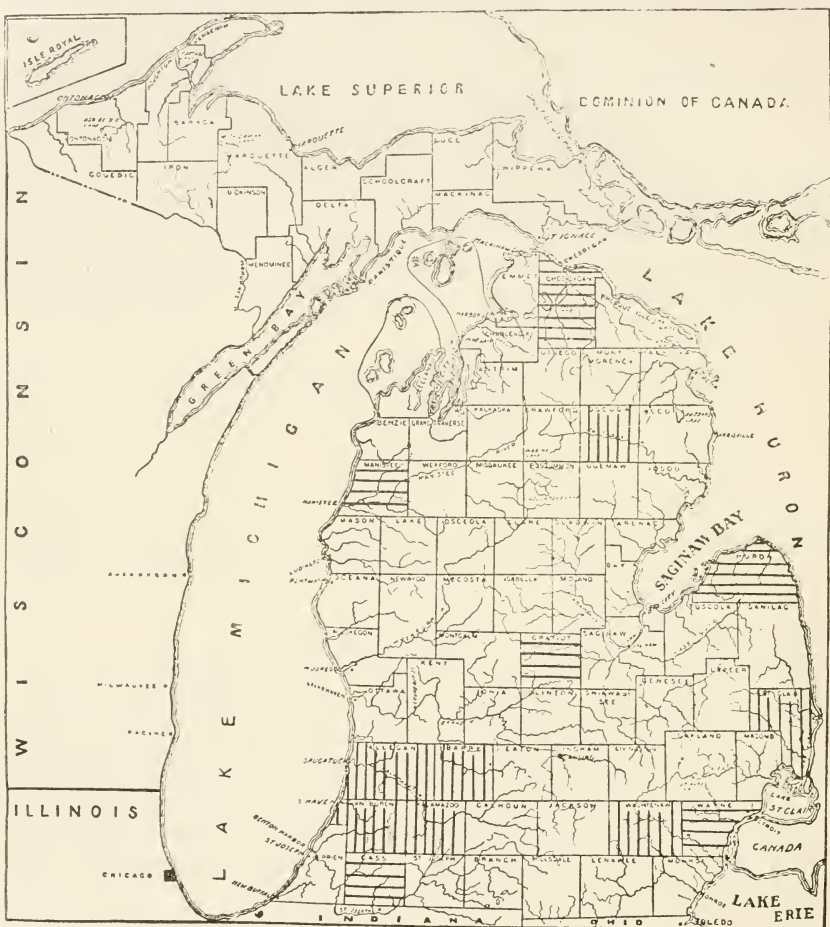


Fig. 31. Distribution of *Heterodon platyrhinus*.

Horizontal ruling, specimens examined; vertical ruling, reports only.

reddish brown or black. When the color is light there are three series of spots—a vertebral row of large spots alternating with a lateral row of smaller ones on either side. Tail cross-banded above. A dark band across the head on the suture between the prefrontals and occipitals and frontal; and another from the orbit to the angle of the mouth. An elongated dark blotch on either side of the neck.

Ventral surface yellow or greenish yellow, occasionally with faint blotches of brown.

In uniformly colored individuals the ground color is greenish olive to black; the ventral surface being immaculate greenish or yellowish. In black individuals the spots are usually entirely wanting; in the olivaceous specimens the black nuchal spots are often distinct, and the vertebral and lateral ones are often faintly in evidence.

Habits and Habitat: As stated below, this species has been found in but few localities in Michigan, but the evidence seems to indicate that it prefers dry woods and occurs particularly in sandy regions. It is one of the most interesting of the northeastern North American snakes. Its stocky build and upturned snout give it a particularly savage appearance, which is greatly enhanced by its peculiar habit of flattening out the fore part of the body, and hissing loudly when disturbed. It also feigns death by throwing itself on its back, writhing as if in agony with the mouth widely opened, and then lying perfectly relaxed. It will retain this posture for a considerable time, and if turned over on the ventral surface will immediately turn over on its back again. Its formidable appearance, and the peculiar habit of flattening its body and hissing loudly have furnished the basis for the most exaggerated stories, earned for it the common names blowing adder, hognosed viper, hissing viper, etc., and given rise to the general impression that it is a very venomous and greatly to be feared serpent. As a matter of fact the eastern hognosed snake is not only entirely harmless but can scarcely be induced to bite, and makes a most interesting snake in captivity. The food seems to consist almost entirely of toads, altho we have observed them to eat frogs in captivity. Insects are often found in their stomachs, but there is no reason to believe that these are taken in any other way than in the stomachs of the toads they have swallowed. The species is oviparous.

Range: The species has been reported from Michigan (Sager, 1839, 302, Miles, 1861, 233), Ann Arbor (Smith, 1879, 6), Wayne, Kalamazoo, Van Buren, Allegan and Barry Counties (Clark, 1905, 110), McKinley, Oscoda County, Manistee, Manistee County and Pearl Beach, St. Clair County (Ruthven, 1909a, 117), Huron County (Ruthven, 1911a, 265), and Cass County (Thompson, 1911, 107). We have seen specimens from Manistee, Detroit, the sand region of Huron County, between Bayport and Port Austin, Alma, Gratiot County, Cass County, and Douglas Lake, Cheboygan County.

From these records it seems probable that the species is to be found commonly, if not almost exclusively, in the more sandy parts of the state.

ELAPHE OBSOLETUS (Say).

PILOT SNAKE.

(Pl. VI.)

Coluber obsoletus, Sager, 1839, 301. Smith, 1879, 6. Clark, 1902, 192; 1903, 172.

Coluber spiloides (Part?), Cope, 1900, 841-843.

Callopeltis obsoletus, Clark, 1905, 110.

Coluber obsoletus obsoletus, Notestein, 1905, 117.

Description: A large snake attaining a length of from five and one-half to eight feet. Head moderately swollen through the jaws, and tapering gradually to the end of the snout, so that it is decidedly elongate; high on the sides; the muzzle usually straight on the sides, occasionally slightly concave in the preocular region. Eye moderate. Nostril lateral. Cephalic plates normal, the frontal plate generally longer than broad.

In the few specimens examined the dorsal scale rows are 25-23-21-19-17 and 23-25-21-19-17.* Supralabials 8, occasionally 7; infralabials 11; occasionally 12. Oculars 1-2. Temporals 2-3, occasionally 2-2. Ventrals 231-236; subcaudals 79 and 80. Anal plate divided.

A very good description of the snake is that given by Hay (1892a, 501): "In this, the general color is a black with a bluish tinge, or a pitch-black, most pronounced on the posterior portion of the body. The anterior half may be lighter, and show evidences of blotches. The whole of this part may have a decided tinge of red, this being due to the color of the skin between the scales; yet the red may run up on the bases of the scales. Occasionally the spots of the upper surface are of a decided red. The dorsal blotches extend down on the sides to about the 7th row of scales, counting the lowest. They are about 6 inches long, and are separated by the length of two scales. Alternating with these is another series which extend from the 3rd to the 7th row of scales. These spots are all feebly indicated by the sulphur yellow of the skin between the scales; and often the color is almost uniform black. There are some scales with yellow or white edges. Lower jaw and throat white. The belly is of a slate-color or black on the hinder half;

*The number of scale rows in the series is usually given as 27, so that the above formulas are probably exceeded in some Michigan specimens. Needless to say this summary of the number of scales in the different series, based as it is on a small number of specimens, is only a very general one.

anteriorly the black is mottled with yellowish, which color becomes more and more abundant, until the throat and chin are entirely yellowish. Small, or even half-grown, individuals may have a ground color of ash-gray and numerous dark blotches."



Fig. 32. Distribution of *Elaphe obsoletus*.
Horizontal ruling, specimens examined; vertical ruling, reports only.

This snake is often confused with the blue racer. It may readily be distinguished from the latter by the carinated scales and greater number of scale rows and the dark markings on the ventral surface.

Habits and Habitat: The writer has been unable to gather any data on the habitat of the pilot snake in Michigan. The food that the species is known to take is as follows: mice (Hay, 1892a, 503),

cotton-tail rabbit (Ditmars, 1907, 305), undetermined insect fragments, undetermined larvae, insects, with bird remains, undetermined species of Orthoptera, Acridiidae (grasshoppers), wood frog, undetermined birds, undetermined eggs, chicken eggs, robin eggs, red-winged blackbird, sparrow, robin, undetermined mammals, common opossum, undetermined mice, meadow mouse (*M. pennsylvanicus*), *Microtus* sp. (uncertain species), house mouse, undetermined squirrels, red squirrels, chipmunk, undetermined shrew, and weasels (Surface, 1906, 160). In the specimen taken at Ann Arbor by Winchell (see infra) the writer finds the remains of an adult sparrow.

The pilot snake is oviparous. Hay (1892, 395) records a pair that were taken in coitu on June 19, and Surface (1906, 159) states that the eggs are laid during the latter part of August or early part of September. Ditmars (1907, 306) writes that a specimen deposited ten eggs on June 26. Surface also states that the eggs are laid in loose earth or damp sawdust; Stejneger (1892, 396) has recorded a batch found in a hollow stump, and Hay (1892, 396) found a number in a pile of stable manure. The last named writer describes the eggs and young as follows: "When found the eggs were glued together in one mass. Each egg is 2 inches long and nearly an inch and a quarter in the short diameter. On the outside is found a thick, leathery, yellow covering, beneath which is a much thinner coat. From one of these eggs I have taken a young snake which measures ten and three-quarters inches in length. Attached to this embryo is a considerable mass of yolk, a condition which indicates that the embryo is not ready for hatching. Nevertheless, all the generic and specific characters are well shown. There is a well developed egg tooth. The intromittent organs are everted in the specimens examined."

Range: The status of this snake in the state is little known. It has been reported from Michigan (Sager, 1839, 301, Smith, 1879, 6), Eaton County (Clark, 1902, 193, 1903, 172), Olivet, Ann Arbor, and Kalamazoo, Van Buren and Montcalm Counties (Clark, 1905, 110). The writer has only seen four specimens that were taken within our limits, one from Alma, Gratiot County, one from Eaton County, one at Ann Arbor, by Alexander Winchell, and one from Lenawee County, by W. J. Beal. Both of the latter specimens are without dates, but they have been in the University of Michigan Museum collection for many years.

ELAPHE VULPINUS (Baird and Girard).

FOX SNAKE.

(Pl. IX a.)

Coluber vulpinus, Notestein, 1905, 117. Smith, 1879, 6. Cope, 1900, 831-833.

Scotophis vulpinus, Baird and Girard, 1853, 75-76. Miles, 1861, 233.

Callopeltis vulpinus, Clark, 1905, 110.

Elaphe vulpinus, Ruthven, 1909a, 110; 1910, 59; 1911a, 266.

Description: A robust snake, attaining a length of about four or five feet. Head rather flat, broad and rather short, being usually decidedly shorter and broader than in *E. obsoletus*. Sides of head rather low, slightly concave in preocular region. Eye moderate, pupil round. Nostrils lateral. Cephalic plates normal; the frontal generally nearly or quite as wide as long.

Dorsal scale rows 27-25-23-21, 25-27-25-23-21, 25-23-21; the first 3 or 4 smooth, the others weakly keeled. Supralabials 8, occasionally 7 or 9; infralabials 9, 10 or 11. Oculars usually 1-2. Ventrals 200-212 (196-217, Cope, 1900, 832); subcaudals 50-65 (68, Cope, 1900, 832). Anal plate divided.

Ground color above yellowish or light brown. A median series of dark chocolate brown blotches with inconspicuous black margins and separated by two scales, the first one or two anterior either entirely or partly divided on the median line. Vertebral spots usually descending to the fifth or sixth rows on the sides, the lower margin being produced in an obtuse angle. A row of smaller blotches alternating with those of the vertebral series on the sides between the second and seventh rows inclusive. These are also margined with black, and in turn alternate with another series of black blotches that involve the edge of the ventrals and the first one or two rows of dorsal scales. Belly pale yellowish with alternating series of quadrate black blotches of which the row involving the first one or two dorsal rows is the outer. Head light brown, with a dusky band across the suture of the prefrontals with the frontal and supraoculars, and another from the eye to the angle of the mouth.

Habits and Habitat: Very little is known of the habits or habitat of the fox snake. In common with some other snakes, it will, when excited, frequently vibrate the tail rapidly like the rattle snakes. As the tail terminates in a horny point, a distinct buzzing sound is produced. It is entirely harmless, and not usually pugnacious.

Ditmars, 1907, 297-298) writes of the food and breeding habits as follows: "The Fox Snake feeds largely upon small rodents, young rats and mice. To procure the former it often haunts the vicinity of barns and sheds where hay or grain is stored. From this habit



Fig. 33. Distribution of *Elaphe vulpinus*.
Horizontal ruling, specimens examined; vertical ruling, reports only.

it is sometimes called the house snake. The fully adult individuals eat mammals as large as half-grown rabbits. They occasionally prey upon birds and will eat their eggs, swallowing them entire and breaking the shell in the throat by the contraction of the muscles. The good this species does in destroying the smaller, injurious creatures of the fields, should cause it to be the recognized

friend of the farmer. One snake is worth a dozen traps, for the reptile prowls into the burrows and nests of rats and mice and eats the entire brood.

"Like all of the Colubers, the Fox Snake deposits a considerable number of eggs, generally in the hollow of a rotting stump, and leaves them without further ado, to hatch within six or eight weeks time. The eggs gradually increase in size by absorbing the moisture of the wood pulp in which they are deposited. Just prior to hatching, an egg is a third or half larger than when it was laid. One of the writer's specimens deposited 12 eggs on the first of July. They were adhesive in a single cluster. These eggs began hatching on the 21st of August, and all had not hatched until about ten days later. The female specimen was three and a half feet in length and in proportion to her size the young were very large." A specimen taken in Huron county by the writer (Ruthven, 1911a, 266) had eaten four young rabbits.

Range: The species has been reported from: Grosse Isle (Baird and Girard, 1853, 75-76), south shore of Saginaw Bay (Miles, 1861, 233), Grosse Isle (Cope, 1900, 832), St. Clair County (Ruthven, 1909a, 110), Dickinson County (Ruthven, 1910, 59), Stony Island and sand region of Huron County (Ruthven, 1911a, 266). Specimens have been examined from: Pearl Beach and Hersen's Island, St. Clair County, Stony Island and Sand Point, Huron County, Brown Lake, Dickinson County, and Monroe County. Captain C. C. McDonald, light-house keeper on Charity Island, has informed the writer that he killed a pair of these snakes in coitu on the island a number of years ago. Captain McDonald is familiar with the species, and the record can be accepted, altho the snake has not since been observed on the island.

NATRIX SIPEDON (Linnaeus).

WATERSNAKE.

Coluber sipedon, Sager, 1839, 302.

Tropidonotus sipedon, Smith, 1879, 6.

Natrix fasciata sipedon, Clark, 1902, 194; 1903, 173. Notestein, 1905, 117. Cope, 1900, 969-972. Clark, 1903b. Hankinson, 1908, 236.

Natrix sipedon, Kirsch, 1895, 333. Thompson, 1911, 106. Ruthven, 1911, 115; 1911a, 269.

Natrix sipedon fasciata, Clark, 1905, 109.

Natrix erythrogaster, Clark, 1902, 194; 1903, 172; 1905, 109; 1903b.

Natrix fasciata erythrogaster, Notestein, 1905, 117.

Tropidonotus erythrogaster, Smith, 1879, 6.

Nerodia agassizii, Baird and Girard, 1853, 41-42. Miles, 1861, 233.

Nerodia sipedon, Baird and Girard, 1853, 38-39. Miles, 1861, 233.

Description: Medium sized snakes of robust form; size three and a half to four feet. Head decidedly swollen at the base of the jaws, rather narrow and elongate, with high and straight sides. The muzzle bluntly sub-conical, so that the nostrils are directed upward to some extent. The nostrils quite small and capable of being closed.

Dorsal scales generally 23-21-19-17; occasionally 21-23-21-19-17; more rarely 23-25-23-21-19-17, and 23-21-19-(17). Labials nearly always 8-10, very rarely 9 (or 7) superior and 9 or 11 inferior scutes in the series. Oculars 1-3, with rare exceptions 1-2 or 1-4. Temporals 1-3 with occasionally 2 in the second row: Ventrals 137-149, subcaudals 56-75. Anal divided.

The coloration of this species has been well described by Cope (1900, 970-971): "In young individuals and in those generally in which the epidermis has been removed, the normal type of coloration is seen to consist of three series of nearly quadrate dark brown spots, with still darker borders, one dorsal and one lateral on each side. These are so disposed that the two corresponding lateral spots are opposite the intervals between the dorsals, and thus appear to be connected by a light line. The longitudinal diameter of the dorsal spots, amounting to three or four scales, is the greater; just the reverse of what is the case with the lateral. Of these lateral spots there are generally about thirty-two on each side from the head to the anus, the spaces between equal to or less than the spots, not greater, as in *T. fasciata*. While the pattern is generally quite distinguishable on the posterior half of the body, anteriorly it becomes confused, the lateral blotches standing opposite to the dorsal and becoming confluent, so that the back appears crossed by lozenge shaped blotches extending to the abdominal scutellae, and this separated on the sides by triangular intervals of a lighter color.

"Occasionally the color appears to be a dull and rather light brown, with the back crossed by narrow transverse lines, with dark (nearly black, but still not distinct) margins." Frequently the general color is so dark that the animal is more or less uniformly dark brown or black above, and in some of the black individuals the belly is red (so called variety *erythrogaster*).

Habits and Habitat: This well known snake is common along

the streams and lakes of southern Michigan. It is never found far from such habitats and generally frequents logs or branches of bushes overhanging the water, into which it glides swiftly on the slightest sign of danger, and conceals itself on the bottom. On

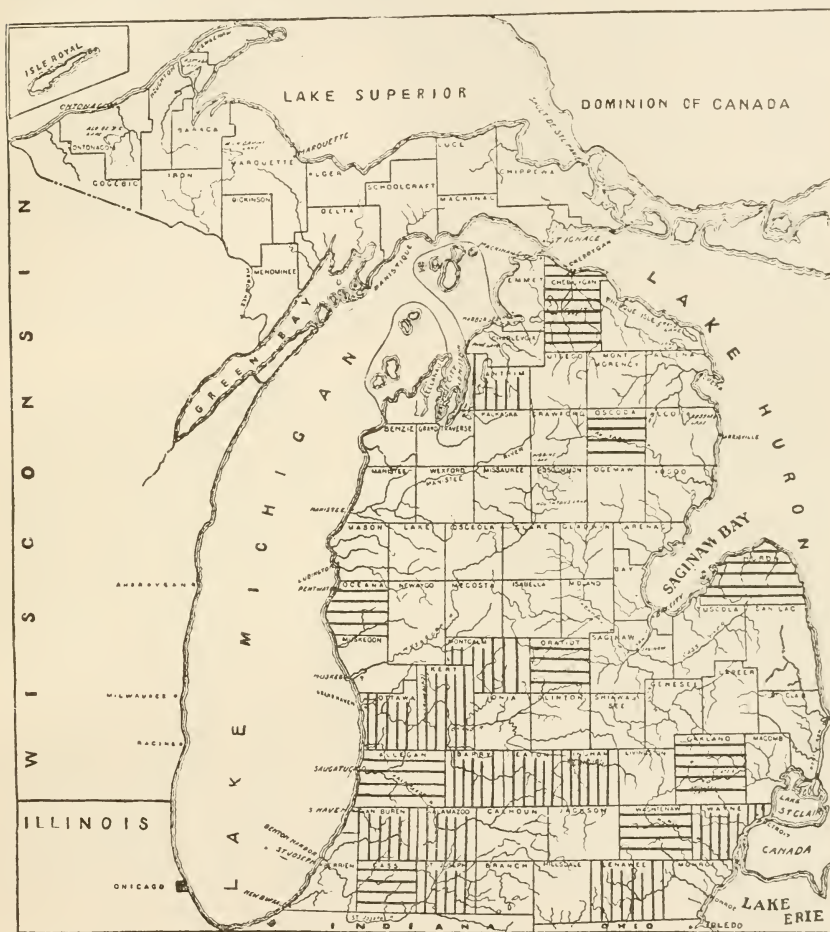


Fig. 34. Distribution of *Natrix sipedon*.
Horizontal ruling, specimens examined; vertical ruling, reports only.

sandy and rocky shores where bushes and trees do not come down to the waters edge (for example, along the Great Lakes) it is found under logs and driftwood.

A considerable variety of food has been recorded in the stomachs of these snakes. Surface (1906, 156) records insect fragments with toad remains, undetermined species of orthoptera, two-striped grass-

hopper, striped brown cricket, undetermined ground beetles, undetermined vertebrates, undetermined fish, catfish, white sucker, *Cottus ictalops*, *Cottus richardsoni*, undetermined salamander, *Plethodon cinereus*, tadpole, toad, green frogs, undetermined mammals, meadow mouse (*Microtus pennsylvanicus*), common shrew (*Sorex personatus*). Atkinson (1901, 150) says that it feeds upon "crustaceans, fish, and batrachians." De Kay (1842, 42) found it feeding on the lake lamprey, bullhead, brook trout, and white sucker. Blatchley (1891, 30) removed seven leopard frogs from a single specimen. Ortmann (1906, 495) states that crawfish form an important part of the diet of this snake. Notwithstanding the variety of food which it is thus evident that the watersnake will eat, fish form by far the greater part of the diet. In the few stomachs which we have examined from southern Michigan specimens, small fish alone were found, and these often in considerable numbers.

Range: The species has been reported from: Grosse Isle and Lake Huron (Baird and Girard, 1853, 38, 39 and 42), Michigan (Sager, 1839, 302; Miles, 1861, p. 233), Ann Arbor (Smith, 1879, 6), Lansing (Cope, 1900, 977), Hudson, Manitou Beach and Tiffin River, Lenawee County (Kirsch, 1895, 333), Eaton County (Clark, 1903, 172; 1903b; 1902, 194), Cass County (Thompson, 1911, 106), Ann Arbor, Lansing, and Olivet, and Antrim, Barry, Kalamazoo, Kent, Montcalm, Ottawa, St. Joseph and Van Buren Counties (Clark, 1905, 109), Huron County (Ruthven, 1911a, 269), Walnut Lake, Oakland County (Hankinson, 1908, p. 256), and Douglas Lake, Cheboygan County (Ruthven, 1911, 115). The writer has examined specimens from Walnut Lake and Pontiac, Oakland County, Washtenaw County, North and Stony Islands and the sand region of Huron County, Charity Island, Saginaw Bay, Douglas Lake, Cheboygan County, Shelby, Oceana County, Cass County, Allegan County, Oscoda County, and Alma, Gratiot County.

REGINA LEBERIS (Linnaeus).

LEATHER SNAKE.

Coluber septemvittatus, Sager, 1839, 302.

Tropidonotus leberis, Holbrook, 1842, IV, 51.

Natrix leberis, Clark, 1902, 194. Notestein, 1905, 116.

Regina leberis, Baird and Girard, 1853, 45-46. Clark, 1905, 110. Smith, 1879, 6. Miles, 1861, 233.

Description: Slender, medium sized snakes attaining a length of about two feet. Head rather flat from the nape, sides low.

Dorsal scale rows 19-17 in every specimen examined, except in a few that have 21 just behind the head. Labials usually 7-10, occasionally 7-9 or 7-11. Oculars 2-2, the preoculars rarely fused into a single scale. One anterior temporal. Ventrals 142-154, subcaudals 65-81. Anal plate divided.



Fig. 35. Distribution of *Regina leberis*.
Horizontal ruling, specimens examined; vertical ruling, reports only.

Ground color above uniformly dark chestnut or chocolate brown, as is also the top and sides of the head above the labials and the lower part of the lower postoculars. A bright yellow band occupies the second and upper part of the first scale row, and is continued on the head to include the supralabials, lower part of the lower postocular and the lower part of the rostral plate. Although

frequently obscure there is a narrow black line on the fifth and occasionally on adjacent parts of the fourth and sixth dorsal rows on either side and one on the median (tenth) row. Occasionally the entire area between the lower lateral line and the light lateral stripe on the second and third rows appears blackish. Ends of ventrals with the lower part of the first scale row usually brownish, forming a dark band. Belly dull yellow with two parallel bands of brown that are broken by the narrow pale margins of the scutes and unite into a single, narrow, median band on the throat.

Habits and Habitat: Little is recorded on the habits of this snake. Morse (1904, 132) states that it is often found hanging over a stream from projecting willows from which it glides rapidly into the water when disturbed." It is apparently quite aquatic. Atkinson (1901, 149) states that in its stomach "crayfish are most frequently found, also occasionally fish and small frogs." Surface (1906, 151) examined four specimens which had eaten crayfish, and one of these had eaten a toad. Ortmann (1907, 495) states that crayfish form an important part of its diet and that he has seen it disgorge *Cambarus obscurus* when captured.

Range: The species has been reported from: Grosse Isle (Baird and Girard, 1853, 45, 46), Michigan (Sager, 1839, 302; Miles 1861, 233; Holbrook, 1842, IV, 51), Ann Arbor (Smith, 1879, 6), Eaton County (Clark, 1902, 194), Olivet and Montcalm, Kalamazoo and Van Buren Counties (Clark, 1905, 110). The writer has examined numerous specimens from Washtenaw County, and one from the vicinity of Manistee, Manistee County.

CLONOPHIS KIRTLANDII (Kennicott).

KIRTLAND SNAKE.

Regina kirtlandi, Smith, 1879, 6.

Clonophis kirtlandi, Clark, 1905, 109.

Natrix kirtlandii, Cope, 1900, 997. Notestein, 1905, 116.

Description: A rather small snake attaining a length of about eighteen inches. Head small and pointed, sloping downward from the nape; sides not concave in front of eye, the latter small and slightly protruding. Nasal plates united above the nostril. The scutellation of the two Michigan specimens examined is as follows:

Dorsals	Supralabials	Infralabials	Oculars	Temporals	Subcaudals	Ventrals
19-17	6	7	1-2	1-2	56	134
19-17	5	7	1-2	1-2	54	130

Ground color light brown and narrowly restricted by large, conspicuous, quadrate, black blotches arranged in two rows on either side. Spots of the lower row larger; those of the two upper rows occasionally fused across the back. The first one or two scale rows



Fig. 36. Distribution of *Clonophis kirtlandii*.
Horizontal ruling, specimens examined; vertical ruling, reports only.

light ash, like the ends of the ventrals. Top of head marbled with black and brown. Supralabials dull yellow. A small, well defined, black spot on the outer end of each ventral scute, forming with its fellows a row of spots along either side of the abdomen. Ends of ventrals outside of spots gray finely speckled with black. Middle of the abdomen said to be red in life, in alcohol it becomes yellow.

Habits and Habitat: This snake is apparently very rare in Michigan. We have seen but two specimens, as stated below. These were both taken in a large tamarack swamp. It is said (Cope, 1900, 997; Ditmars, 1907, 262) to frequent damp woods and to be found generally under logs; also that when near it it will take to the water and dive to the bottom like a true water snake. It is reported to feed largely on small frogs and toads, and that captive specimens will eat fish (Ditmars, 1907, 262) and slugs (Atkinson, 1901, 150). The young are born alive.

Range: The species has been reported from: Ann Arbor (Smith, 1879, 6), Kalamazoo (Cope, 1900, 997) Ann Arbor and Kalamazoo (Clark, 1905, 109).

The two specimens of this snake described above were taken near Ann Arbor. They are the only ones the writer has seen.

LIOPELTIS VERNALIS (DeKay).

GRASS SNAKE.

Coluber vernalis, Sager, 1839, 302.

Liopeltis vernalis, Smith, 1879, 7. Clark, 1902, 193; 1905, 110.

Notestein, 1905, 118. Cope, 1900, 782-784. Ruthven, 1911, 115; 1911a, 267.

Chlorosoma vernalis, Miles, 1861, 233.

Description: A slender and rather small snake, attaining a length of one and one-half feet. Body about same diameter throughout, i. e., not tapering strongly toward the extremities, but the head well marked off. Cephalic plates normal in arrangement, rostral normal in form. Sides of head high, but muzzle short which tends to crowd out the plates in front of the eye. Nasals fused. Loreal when present of normal height but nearly as often absent as present; when absent it is fused with nasal. Nostril lateral.

Dorsal scale rows 15 throughout the entire length of the body, scales smooth. Supralabials usually 7, occasionally 8; infralabials usually 8, frequently 7, and rarely 9. Oculars usually 2-2, occasionally 1-2, rarely 1-3 or 2-3. Ventrals 123-134; subcaudals 71-84 (Baird and Girard cite an example with 94). Anal plate divided.

Uniformly bright green above and yellowish white beneath.

Habits and Habitat: The grass snake is an exceedingly beautiful, agile, and harmless little snake that in Michigan is usually found in dry open clearings. It is generally on the ground but may climb small shrubs. The following definite observations on the food habits have appeared in the literature: snails, spiders, insect fragments, larvae, unidentified orthoptera, crickets, grasshoppers, un-

identified lepidoptera, measuring worms, ground beetles (*Harpalus* sp.), red ants, striped salamander (Surface, 1906, 165-166); insects (Ditmars, 1907, 324-325); grasshoppers (Atkinson, 1901, 148); spiders, grasshoppers and crickets, but in preference to anything

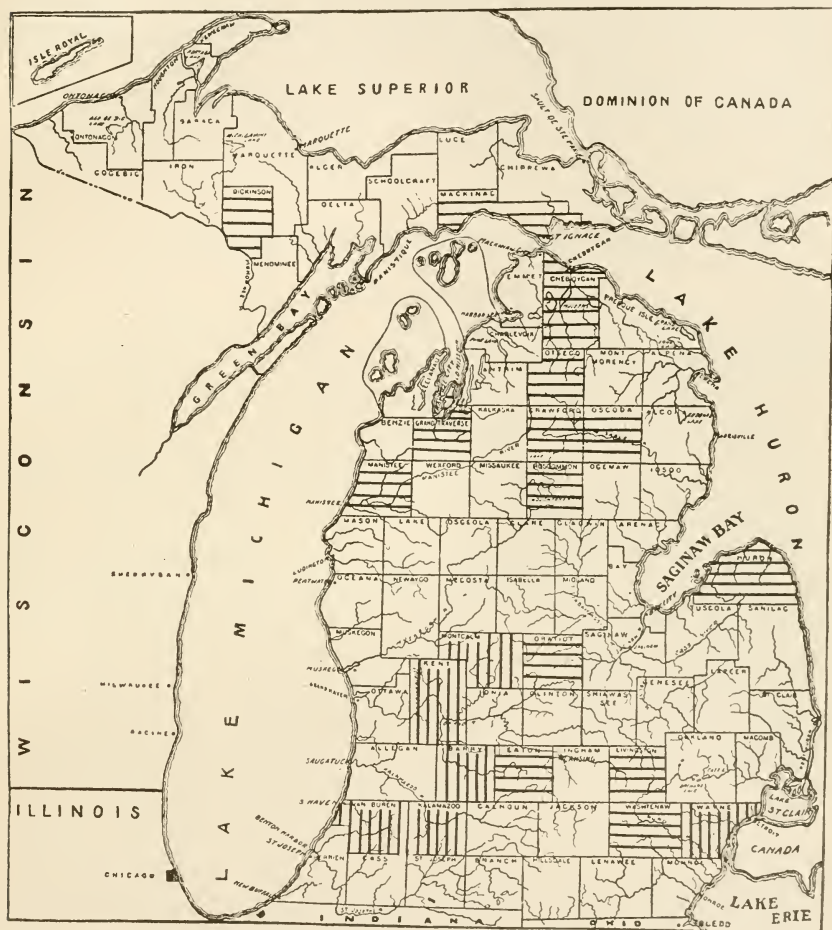


Fig. 37. Distribution of *Liopeltis vernalis*.
Horizontal ruling, specimens examined; vertical ruling, reports only.

of this character will take the larvae or caterpillars of certain moths" (Ditmars, 1907, 325).

Range: The species has been reported from: Michigan (Sager, 1839, 302; Miles, 1861, 233), Ann Arbor (Smith, 1879, 7), Detroit (Cope, 1900, 783), Eaton County (Clark, 1902, 193), Olivet, Ann Arbor, and Barry, Kalamazoo, Kent, Montcalm and Van Buren

Counties (Clark, 1905, 110), Huron County (Ruthven, 1911a, 267) and Cheboygan County (Ruthven, 1911, 115). Specimens from the following localities have been examined: Ann Arbor, Washtenaw County, Au Sable River, Oscoda County, Brighton, Livingston County, Higgins Lake, Roscommon County, Grayling, Crawford County, Traverse City, Grand Traverse County, Bad Axe and Sand Point, Huron County, Manistee, Manistee County, Douglas Lake, Cheboygan County, Brown Lake, Dickinson County, Alma, Gratiot County, Eaton County, Mackinac County, and Dr. F. N. Notestein informs me that he saw specimens in Otsego County in 1911.

DIADOPHIS PUNCTATA (Linnaeus).

RINGNECKED SNAKE.

Coluber punctatus, Sager, 1839, 302.

Diadophis punctatus, Clark, 1902, 193; 1905, 110. Notestein, 1905, 119. Smith, 1879, 7. Ruthven, 1906, 111; 1911, 114. Miles, 1861, 233. Cope, 1900, 751-753.

Description: A small snake that attains a length of about a foot or eighteen inches. Head flat and broad, low on the sides. Eye small. Two nasal plates.

The scutellation is described as follows: Dorsal scale rows 15, the scales smooth. Supralabials usually 8, often 7; infralabials 8. Oculars 2-2, temporals 1-1. Ventrals 141-161, subcaudals 36-56. Anal plate divided. In the three specimens examined by us (from Ann Arbor, Olivet and Oakland County) the scutellation is: dorsals 15 throughout the length of the body, supralabials 7-8, 7-7, 8-7, infralabials 8-8, 7-7 in two, oculars 2-2 in two, 2-1 in one, temporals 1-1 on each side, ventrals 144, 148, 159, subcaudals 57, 50, ?.

The writer has seen but one live specimen of this snake in Michigan. Hay (1892a, 493) describes the coloration as follows: "The color above varies in the subspecies, or varieties, from olive through gray to blue-black; below from yellowish white to orange and red, with more or fewer dark spots. There is usually a light ring around the neck, close to the head.

"The form in Indiana is the typical *punctatus*. The color above is a bluish black or a dark ash, with a wash of bronzy that extends down to the lowest rows of scales. Below, the color is orange or deep red, somewhat palest in front. On the outer ends of each of the ventrals there is a small black spot, and these are involved in the color of the dorsal scales. Near the middle line of the ventrals may be two rows of dark spots, or the spots on the ventrals may

unite to form transverse bars. The ring around the neck is orange, edged with black. It is one or two scales in width. Upper labials yellow."

Habits and Habitat: But little has been recorded on the habits of this snake. By far the best account is that of Ditmars (1907, 335). "The Ringnecked snake is a secretive species, hiding under the loose, rotting bark of fallen trees, among loose rocks or under flat stones. It is seldom seen abroad and if it ventures from its lairs, usually prowls at night. In the North the writer has collected large numbers of these pretty snakes by turning over flat stones. He remembers a particular stone, about the size of an ordinary platter, lying near the edge of heavy timber, in Sullivan County, New York, that appeared to be a favorite hiding place for snakes of this species. In his daily trips to the woods, this stone was always turned over, and generally to disclose a ring-necked snake, snugly coiled beneath it. Many specimens were taken at this spot. They had apparently prowled about the clearing at night and on their way back to the thicket, and its hiding places, had discovered the shelving stone.

"In the South, large numbers of these reptiles were collected by stripping the bark from fallen trees. To find fifty or more specimens during a half-days hunt for various reptiles that select such hiding places, was not unusual. The Ringnecked Snakes were most frequently found under the bark of trees infested by ants; often the working streams of these insects would pass but a fraction of an inch from the spot where the reptile lay coiled. In one instance, while pursuing some entomological investigations during the early spring, the writer exhumed one of these snakes while digging through a large and thickly populated ant hill."

The Oakland County specimen (see below) was found under the bark of a decaying stump.

It has been said to feed on the following forms: snakes, lizards, amphibians, insects and earthworms. Specific records are as follows: green snake, *Liopeltis vernalis*, and red-bellied snakes, *Storeria occipitomaculata* (Ditmars, 1907, 336); frog, *Engystoma carolinense* (Cope, 1900, 753); beetles and earthworms, (Atkinson, 1901, 148); insects (beetles and undetermined fragments), salamander, *Plethodon cinereus*, and undetermined remains (Surface, 1906, 173).

The ringnecked snake is oviparous. The following account of the breeding habits is from Surface (1906, 172). "The latent gonads or undeveloped eggs are one-fourth inch in length and commence to

develop in May, when they reach a length of one-half inch, and by the middle of June they are practically developed or over one inch long. They are laid from the middle of June to July or August and each is covered with a thin opaque shell, white and leathery, and



Fig. 38. Distribution of *Diadophis punctata*.

Horizontal ruling, specimens examined; vertical ruling, reports only.

very irregular in shape and size. They hatch in September and October, and the young are about four inches in length at the time of hatching."

Range: The ringnecked snake is evidently rare in the state. The species has been reported from Michigan (Sager, 1839, 302; Miles, 1861, 233), Ann Arbor (Smith, 1879, 7), Grayling (Cope, 1900,

753), Eaton County (Clark, 1902, 193), Olivet, Kalamazoo, Montcalm and Van Buren Counties (Clark, 1905, 110), Marquette (Ruthven, 1906, 111), Pine Lake, Oakland County (Ruthven, 1911, 114), but there is great probability that some of these records refer to young specimens of *Storeria*. The Marquette record is particularly open to question and has not been recorded upon the map. We have seen specimens from: Ann Arbor, Washtenaw County (a single specimen taken many years ago and now in the Museum), Pine Lake, Oakland County, Olivet, Eaton County, Alma, Gratiot County, and Douglas Lake, Cheboygan County, and Dr. F. N. Notestein informs the writer that he saw the species in numbers in Otsego County in 1911.

BASCANION CONSTRICTOR (Linnaeus).

BLUE RACER.

(Pl. X.)

Coluber constrictor, Sager, 1839, 302.

Bascanion constrictor constrictor, Notestein, 1905, 119. Clark, 1905, 110. Smith, 1879, 7.

Bascanion foxii, Baird and Girard, 1853, 96. Miles, 1861, 233.

Zamenis constrictor, Clark, 1902, 193; 1903, 172-173.

Bascanion constrictor foxi, Smith, 1879, 7.

Bascanion constrictor, Baird and Girard, 1853, 93-94. Whittaker, 1905, 100-102. Miles, 1861, 233. Cope, 1900, 791-797. Hankinson, 1908, 236. Thompson, 1911, 107.

Description: A large snake that often attains a length of about six feet. Head somewhat flattened from the nape, but profile curving downward anterior to the eye, high on the sides and sides concave in front of eye. Nostril and eye large.

Dorsal scale rows 17-15 in every specimen examined. Supralabials 7, frequently 8; infralabials 8 or 9. Oculars 1-2, generally a small plate under the preocular. Temporals usually two in the first row. Ventrals 175-192; subcaudals 88-92. Anal plate divided.

Michigan specimens when adult usually uniformly dull bluish green above, rarely darker than dark olive, becoming black only on the temporal region and more or less brownish toward the end of the muzzle. Color of ventral surface nearly always greenish or bluish white, although frequently tinged with yellow.

The young differ so markedly from the adults that a superficial examination would seem to indicate that they belong to a different species, and as a matter of fact they are frequently confused with

the milk snake (*Lampropeltis doliaetus triangulus*). Specimens less than one and one-half feet in length may be described as follows: ground color dark olive, this color belonging mostly to the centers of the scales, the edges being paler. A row of large blotches on the back, extending about to the fourth row of scales, about 3 to 4 scales long, and separated on the median line by about the length of half a scale. These spots with dark brown to black margins, the centers, in some cases at least, light brownish olive. Exterior to the dorsal blotches, on the first four rows of dorsal scales, numerous small and irregular black spots. Top and sides of head, and the pale ventral surface also marked with numerous small, black spots.

Habits and Habitat: The blue-racer is most frequently found in dry, open situations, generally near or in thickets. It also frequents hedge rows, and stone walls. It is a good climber and is not infrequently found several feet from the ground in bushes and twenty or thirty feet up in trees (Plate X). It is extremely graceful and agile as are all of the members of the genus, and very frequently eludes a would be captor. It will fight furiously when cornered or captured, but its small teeth can do little more than puncture the skin. As every herpetologist knows, the blue-racer is not venomous (as popularly supposed), but entirely harmless, so that even the largest specimens may be handled with impunity. Indeed they make rather interesting pets, and soon cease to resent handling. The senseless slaughter of this beautiful snake is as much a disgrace to any civilized community as is the similar destruction of song birds, and an all too common occurrence in southern Michigan. Large and conspicuous, the adults often fall prey to the ignorance and superstition of people who should know better. The writer recalls an instance when a farmer showed him with great satisfaction six splendid specimens not one of them under five feet, which he had killed in a brush pile, under the impression that he was greatly benefiting the community by ridding it of six very dangerous animals.

The food of the blue-racer consists of small mammals, birds, bird eggs, other reptiles, amphibians and possibly insects. Exact records of stomach examinations or direct observations of the food habits are few. The principle food seems to be small mammals, and birds probably occupy a second place. Surface (1906, 170) states that in the Pennsylvania specimens examined by him the meadow mouse (*Microtus pennsylvanicus*) formed a large percent of the stomach contents. He sums up the results of an examination of a series of stomachs as follows: insects 25% ; snakes (garter snakes,

green snake, water snake) 15% ; field mice 22% ; bird eggs (robin) 8% ; rabbits 4% ; voles 4% ; frogs (green frog, wood frog) 7½% ; birds 4% ; mammals unidentified 7% ; larvae of Royal Moth 31½% . Atkinson (1901, 147) records a weasel in the stomach of a Pennsylvania specimen.

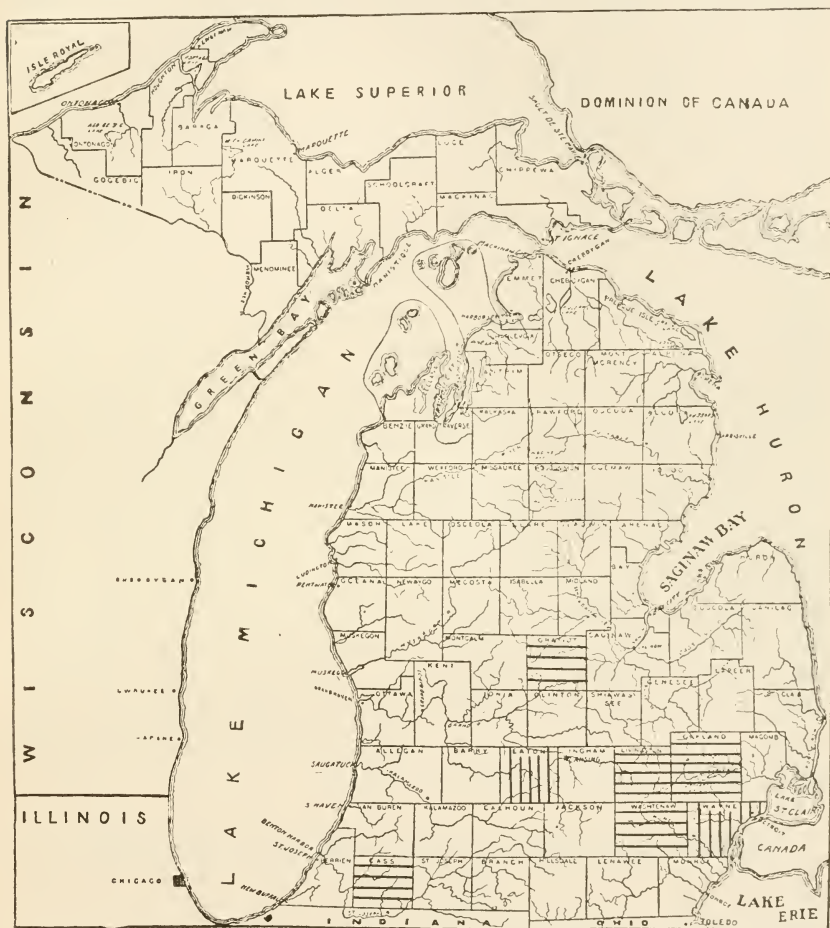


Fig. 39. Distribution of *Bascanion constrictor*.
Horizontal ruling, specimens examined; vertical ruling, reports only.

The writer has never been able to induce captive specimens of this snake to eat toads or frogs but that they prey on these forms to some extent is proved by the observations of Surface. It will probably be found, however, that amphibians form a very minor part of the food. Also as regards insects it is doubtful if the blue-racer preys on any of these directly except possibly the large

lepidopterous larvae. That snakes are eaten is shown by the observations of Cragin (1878, 820-821), Verrill (1869, 158-159), Coues (1878, 269), Ditmars (1907, 282), Surface (1906, 168), and Putnam (1868, 136); and it is interesting to note that in the instance observed by Verrill it was a copper-head that was eaten, while the specimen observed by Coues killed and devoured a rattle-snake. This suggests that the species is, like the king-snake, immune to the poison of these venomous serpents.

Early writers supposed that this snake was a constrictor, a fact denied by some later writers. The truth is about mid-way between these views. In capturing small prey it simply seizes the animal in the mouth as do garter snakes, or at most after seizing the prey partly holds it by covering it with a portion of its body. This is exactly the same as does the king snake (*Lampropeltis getulus*), which is commonly said to be a constrictor. It is true of both species that when a snake is captured the captor winds a coil or two about the captive and thus secures it until swallowed. When a king snake captures a large mammal (e. g., a rat) it constricts it until dead, and it is possible that the blue racer does likewise.

Range: The species has been reported from: Michigan (Sager, 1839, 302; Miles, 1861, 233), Ann Arbor (Smith, 1879, 7), Eaton County (Clark, 1902, 193; 1903, 172, 173; Whittaker, 1905, 100-102), "Oceana and Muskegon to Arenac. Saginaw and St. Clair Counties and southward" (Clark, 1905, 110), Grosse Isle (Cope, 1900, 795, 797; Baird and Girard, 1853, 93-94), Walnut Lake, Oakland County (Hankinson, 1908, 236), and Cass County (Thompson, 1911, 107). We have examined specimens from various parts of Washtenaw County, from Walnut Lake, Oakland County, Alma, Gratiot County, Cass County, and the photographs (Pl. X) were made near Hamburg, Livingston County.

LAMPROPELTIS DOLIATUS TRIANGULUS (Boie).

MILK SNAKE.

Coluber eximius, Sager, 1839, 302.

Ophibolus eximius, Miles, 1861, 233.

Ophibolus triangulus, Smith, 1879, 6.

Osceola doliata triangula, Clark, 1902, 194, and 1904, 173.

Lampropeltis doliatus triangulus, Clark, 1905, 110. Notestein, 1905, 118-119. Hankinson, 1908, 236. Ruthven, 1911, 115, 1911a, 267-268.

Ophibolus doliatus triangulus, Thompson, 1911, 107.

Description: A medium sized snake, attaining a length of about

three feet. Body of nearly the same diameter from the head to the tail. Head relatively small, broad and flat, as compared with the usual form as exhibited, for instance, in the garter snakes. The sides of the head are low in the milk snake so that the nasals, loreal and oculars are also low, and the whole head is short, and the eye small. Cephalic plates normal in number and form. Rostral normal. Temporals usually 2 in the first row. A single loreal. Nasals two, the nostril between them.

Dorsal scale formula usually 21-19-17; scales smooth and with two pits. Supralabials 7; infralabials usually 9, occasionally 7 or 8. Oculars 1-2. Temporals usually 2. Ventrals 195-204; subcaudals 42-51. Anal plate entire.

Ground color brownish ash or brownish yellow. Five series of dorsal blotches of which those of the median row are much the largest, broader than long and involve twelve to fifteen rows across the back. They are chestnut brown (inclining to red in the young) to olive brown in color, and bordered with black. On the sides, involving the second to fifth rows, and alternating with the vertebral series, a row of smaller circular brownish spots, and below and alternating with these another series of small black spots that involves the edges of the ventral plates and the first one to three dorsal scale rows. Belly white blotched with small squares of black. Tail crossed by half rings of black. A dark band across the posterior half of the prefrontals another from the eye to the corner of the mouth. On the nape a large spot of the ground color usually surrounded by extensions of the first dorsal blotch, these extensions uniting again on the parietals in a blotch that includes a V or heart-shaped spot of the ground color; but there are many variations from this arrangement.

Habits and Habitat: The milk snake is a rather common snake in southern Michigan, although not as frequently seen as some of the other species. Its apparent rarity is due to its secretiveness. It lives principally in and under fallen logs in the woods, but is found commonly about barns and outbuildings, probably in search of food. The name is a misnomer and originated in the popular idea that these snakes suck cows or steal milk from pans in the dairies. It is hardly necessary to state that this is an absolute fallacy. The food, as shown by examinations of stomach contents and by direct observations, is as follows: slugs, unidentifiable invertebrates, red-bellied snake (*Storeria occipitomaculata*), DeKays snake (*Storeria dekayi*), unidentifiable bird, robins eggs, unidentified mammals, jumping mouse, unidentifiable mouse, meadow mouse, *Microtus* sp?, white footed mouse, house mouse (Surface, 1906,

1839, 302; Miles, 1861, p. 233), Ann Arbor (Smith, 1879, p. 6), Eaton County (Clark, 1902, p. 194), Ann Arbor, Kalamazoo and Olivet, and Antrim, Barry, Montcalm, Kent, Ottawa and Van Buren Counties (Clark, 1905, p. 110), Douglas Lake, Cheboygan County (Ruthven, 1911, 115), Oakland County (Hankinson, 1908, p. 236), Stony Island and the sand region of Huron County (Ruthven, 1911a, 267-268), Cass County (Thompson, 1911, 107). The writer has examined specimens from the following localities: Ann Arbor, Washtenaw County; Brighton, Livingston County; Jackson, Jackson County; Pontiac and Walnut Lake, Oakland County; Shelby, Oceana County; Charity Island, Saginaw Bay, Stony Island and the sand region of Huron County, Douglas Lake, Cheboygan County, Alma, Gratiot County, Osceola County, Cass County.

THAMNOPHIS SAURITUS (Linnaeus).

RIBBON SNAKE.

(Pl. VI.)

Coluber saurita, Sager, 1839, 302.

Eutaenia sauritus, Miles, 1861, 233. Notestein, 1905, 114. Smith, 1879, 6.

Thamnophis saurita, Clark, 1902, 194; 1905, 109. Ruthven, 1906, 112; 1908, 112-119; 1911a, 269.

Thamnophis faireyi, Kirsch, 1895, 333.

Description: A slender, long-tailed snake, attaining a length of two to two and one-half feet. Head small, distinct from neck, rather high on the sides, slightly concave in preocular region. Cephalic plates normal; two nasals; one loreal. Nostrils lateral, between nasals.

Dorsal scale rows 19-17. Supralabials usually 7, occasionally 6 or 8; infralabials 10, occasionally 9 or 11. Oculars 1-3, occasionally 1-2; temporals 1 in the first row, and 2 in the second. Ventrals 157-169; subcaudals 87-112. Anal single.

The ground color above is usually chocolate brown, varying from light olive-brown to black. There are three light yellowish stripes—a dorsal (on the median and halves of adjacent rows) and two laterals (on the third and fourth rows)—all three of which are usually brightly colored, the dorsal generally tinged with orange, the laterals with green. The lateral black spots generally found on the skin in the garter snakes are seldom distinct, but are not always entirely fused. The ground color of the head is like that of the dorsal surface. There is usually a small pair of bright yellow spots

on the suture of the parietals, and another large yellow spot on the preoculars. The labials are generally nearly white and without black markings. The belly is pale greenish and ventral spots are usually wanting.

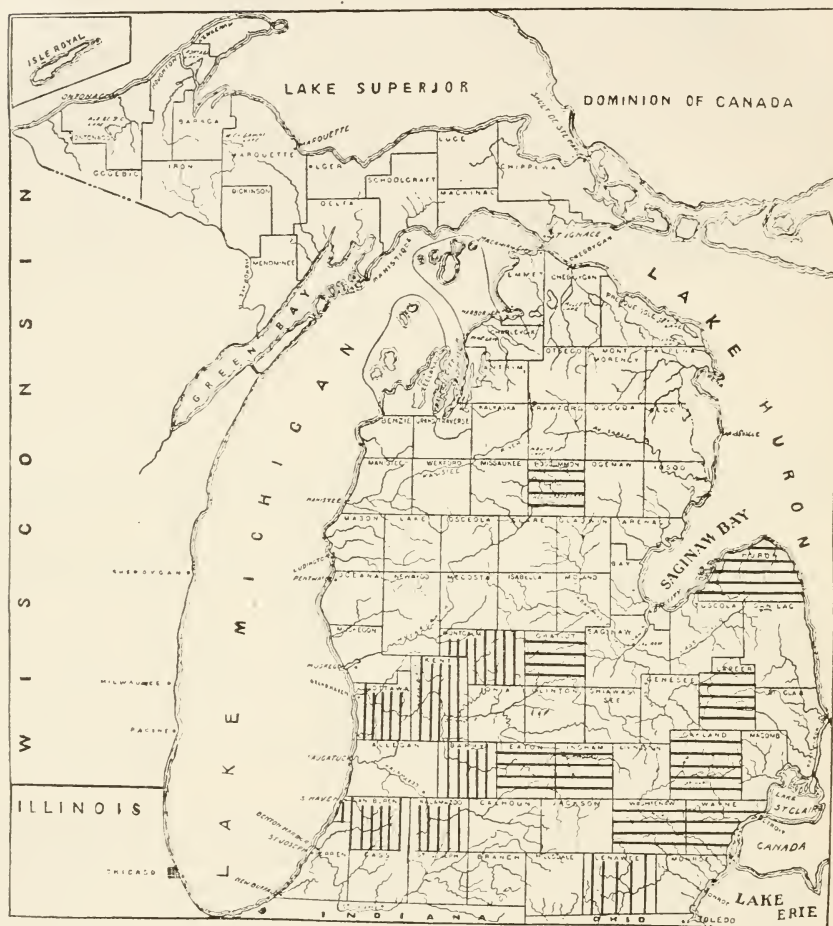


Fig. 41. Distribution of *Thamnophis sauritus*.
Horizontal ruling, specimens examined; vertical ruling, reports only.

Habits and Habitat: Ruthven (1908, p. 112) describes the habits of this form as follows: "Like the other members of the group, *sauritus* seems to be more than ordinarily aquatic in its habits, but apparently less so than either *proximus* or *sackeni*. In Michigan we have generally found it about the margin of ponds and streams in damp woods. It is somewhat of a climber, and is occasionally

found in bushes, several feet from the ground. When pursued it glides through the pools and herbage at an astonishing rate, and does not hesitate to take to water and conceal itself among the water plants, but it generally remains near the surface, and we have never observed it dive to the bottom like a natricid snake. There are numerous short notes in the literature, to the effect that *sauritus* prefers damp situations.

"Ditmars (1907, 217-219) states that it feeds on salamanders, tadpoles, frogs, and fish, but, like *sackeni*, refuses earthworms. Two other writers, Atkinson (1901, 151) and Surface (1906, 142-143), record insects in stomachs examined. The latter gives the following as making up the stomach contents of Pennsylvania specimens: Earthworms, spiders, insect fragments, ants, *Plethodon cinereus*, *Spelerpes bilineatus*, *Hyla versicolor*. It should be noted that the insects may have been contained in the stomachs of the frogs and salamanders. The number of young is comparatively small; we have counted the embryos in a few specimens, and they seem to average about a dozen."

Range: The eastern ribbon snake is not very common in Michigan, at least it is rarely taken by collectors. It has thus far only been found in the southern peninsula. The specimen from Roscommon County, listed below, is the most northern record. A specimen has been recorded from Isle Royale in the museum catalog (Ruthven, 1906, 112), but this record is very doubtful and has not been indicated on the map. It has been reported from: Michigan (Sager, 1839, 302; Miles, 1861, 233), Hudson, Lenawee County (Kirsch, 1895, 333), Ann Arbor (Smith, 1879, 6), Eaton County (Clark, 1902, 194), Ann Arbor, Olivet, and Barry, Kalamazoo, Kent, Montcalm, Ottawa and Van Buren Counties (Clark, 1905, 109), Roscommon, Gratiot, Eaton, Washtenaw, Lapeer, Ingham Counties (Ruthven, 1908, 112), the sand region of Huron County from Sand Point to Port Austin (Ruthven, 1911a, 269). Specimens from the following localities have been examined: various parts of Washtenaw County, Pontiac and Walnut Lake, Oakland County, Detroit, Wayne County, Alma, Gratiot County, Eaton County, Lapeer County, and Lansing, Ingham County.

THAMNOPHIS BUTLERII (Cope).

BUTLER GARTER SNAKE.

Eutainia brachystoma, Clark, 1903a, 1904, 194.

Eutaenia butleri, Notestein, 114.

Thamnophis butleri, Clark, 1905, 109. Ruthven, 1904, 289-299; 1909a, 116; 1908, 87-96; 1911a, 268-269. Whittaker, 1905.

Description: A small rather thick-bodied snake attaining a length of about twelve inches. Head small and usually not very distinct from neck, somewhat elevated behind, and sloping quickly down to the point of the snout. Muzzle short. Sides of head moderately high, concave in preocular region. Eye small. Cephalic plates normal; two nasals and one loreal. Nostril lateral, between the nasals.

Dorsal scales usually 19-17, occasionally 17-19-17 or 17-19-17-15. Supralabials 6 or 7, rarely 8, average between 6 and 7; infralabials 6, 7, 8, 9, or 10, average between 8 and 9. Temporals 1 in first row and 1 large or 1 large and 1 small in second row. Ventrals 134-146 (males), 132-140 (females), subcaudals 61-66 (males), 49-58 (females). Anal plate single.

Ground color above some shade of dark olive brown, with three (a dorsal and two lateral) bright yellow or greenish yellow stripes. The dorsal stripe is usually on the median and halves of the adjacent rows, and the laterals upon the third and more or less of the second and fourth rows. The color of the first and adjacent half of the second rows of scales is generally not lighter than the ground color above. There are two rows of black spots on the skin—encroaching on the scales along the stripes in specimens light enough to show them—but these often lose their identity by fusing irregularly. Belly pale greenish, the only markings being a small black spot at either end of each ventral scute.

Habits and Habitat: The following account of the habits of this snake is taken from the monograph of the genus by the writer (Ruthven, 1908, 89-91): "In southern Michigan I have only taken it in the immediate vicinity of water, either about the margin of swampy places or on the banks of streams. This may be a coincidence, but it is in accord with all of the specimens collected throughout the range which have habitat data. I have found them most frequently by overturning boards, etc., in such places, although they are also found crawling about in the long grass and herbage.

"It is in disposition a rather sluggish snake, seldom attempts to

defend itself, and when surprised is usually easily captured. The ease with which they are captured is in part due to their inability to escape, owing to the extreme awkwardness of their movements on land. When moving slowly this is scarcely noticeable, but when they attempt to move rapidly to escape capture their efforts are peculiarly odd and ineffective. The movements consist in throwing the body in long curves in a manner closely analogous to the wiggling motion by which garter-snakes swim in deep water, and which results in much movement and muscular effort, but very little progress. This movement may be greatly augmented by putting the snake on a smooth surface, but it is not entirely due to the nature of the surface, as it can scarcely make any headway on a surface where *sirtalis* will glide away with comparative ease. This is one of the most striking characteristics of *butleri* and was first noticed by Reddick (1895, 261), who comments upon it in the following words: 'It is short and chubby, and its movement is very characteristic of it. It does not have the gliding movement of *E. saurita* nor the swift and active movement of the *Natrix sipedon*, but seems rather to exert a large amount of force to do little crawling. The movement is so characteristic that I believe anyone having once seen the peculiar way in which it tries to hurry itself away would ever after be able to recognize it at a distance.'

'Fortunately no doubt attaches to the species which Mr. Reddick had, for the specimen upon which this observation was based has been examined, and it is unquestionably a *butleri*. The movement seems to be very similar to the method of locomotion described for the so-called *atrata* specimens of *ordinoides* by Ditmars (1907, 227).

'Observations upon the food habits of *butleri* are but fragmentary. As announced in 1904, it is fond of earthworms and small frogs, but I have since found that in captivity it apparently prefers small fish. As a rule it is impossible to get them to take either worms or frogs if dead, but it is apparently a matter of unconcern to them whether the fish be alive or dead, as they will greedily eat specimens of the latter which have begun to decompose. Young individuals four or five days old will eat as many as three or four small minnows successively.

'Females taken in July are usually pregnant, and the number of young is apparently small. In the specimens examined the number of embryos is about twelve to fifteen. One specimen which was taken in late July, 1905, and kept in captivity gave birth during the first part of August to ten young. The members of this brood were not all born on the same date, but appeared at different times

between August 7 and 20, a difference of thirteen days. This is an unusual occurrence among the garter-snakes, and is undoubtedly abnormal, for, as far as we have observed, it has been invariably the rule that the entire brood appeared within a few hours at most.



Fig. 42. Distribution of *Thamnophis butleri*.
Horizontal ruling, specimens examined; vertical ruling, reports only.

We have seen but one other specimen give birth to young, and there were four in this brood. The young when but a few days old will struggle eagerly with earthworms or minnows, capturing the latter in a small dish of water or taking them from the fingers. For the first three or four days they are very secretive and can be seen only by overturning the moss and stones in the cage, except when they

come out to feed. They have not been observed to feed during the first three days, but after this they will come out freely to gorge themselves on fish, returning again beneath the stones when satisfied. One of these young snakes was kept for three months, in which time it attained to the respectable length of 150 mm."

An additional observation on the food-habits was made in 1908, when several leeches were taken from the stomach of a specimen taken under a stone on the shore of Stony Island, Huron County (Ruthven, 1911a, 268). In nature the form probably subsists largely on such weak food.

Range: *Thamnophis butlerii* is rather common in southern Michigan as far north as the tier of counties represented by Eaton, Oakland and Ingham. A few specimens taken by the State Biological Survey on the south side of Saginaw Bay (Rush Lake and Stony Island, Huron County) in 1908 represent the most northern record, and they were apparently rare in that region (Ruthven 1909a, 116; 1911a, 268). It has been reported from Olivet, Eaton County (Clark, 1903a, 83-88), Brighton, Livingston County, Washtenaw County, Eaton County (Ruthven, 1904), Pontiac, Oakland County (Ruthven, 1908, 92), and Ann Arbor and Chelsea, Washtenaw County (Clark, 1905, 109).

THAMNOPHIS SIRTALIS (Linnaeus).*

GARTER SNAKE.

(Pl. XII.)

Coluber sirtalis, Sager, 1839, 302.

Thamnophis sirtalis, Clark, 1905, 109; 1902, 194. Kirsch, 1895, 333.

Ruthven, 1909, 332-333; 1908, 176-186; 1911, 115; 1911a, 268.

Hankinson, 1908, 236. Thompson, 1911, 106.

Eutaenia sirtalis sirtalis, Notestein, 1905, 115. Ruthven, 1904a, 189-191. Cope, 1900, 1069-1074.

Thamnophis sirtalis sirtalis, Ruthven, 1906, 31, 34, 36, 49, 50, 111.

Sperry, 1903, 175-179.

Eutaenia sirtalis ordinatus, Notestein, 1905, 115.

Eutaenia sirtalis parietalis, Notestein, 1905, 115. Smith, 1879, 6.

Thamnophis sirtalis parietalis, Ruthven, 1906, 49, 50, 53, 111-112.

Clark, 1902, 194. Sperry, 1903, 175-179.

*Although recorded from the state the western subspecies *T. s. parietalis* does not occur within our limits. Nevertheless some Isle Royale specimens have the interspaces between lateral spots generally suffused with red, showing a strong tendency toward the western variety (Cf. Ruthven, 1906, 111-112.)

Description: A medium sized snake attaining a length of one and a half to two or three feet. Head generally well elevated behind, elongate, high and straight on sides, concave in preocular region. Cephalic plates normal. Two nasals and one loreal; nostril lateral and between the two nasals.

Dorsal scales 19-17, supralabials 7, occasionally 8, much more rarely 6; infralabials 10, occasionally 8, 9 or 11. A single preocular and usually 3 postoculars. A single anterior temporal. Ventral plates 144-168; subcaudals 54-84. Anal plate single.

The coloration consists of three light stripes on a darker ground, the lateral stripes on the second and third rows, the dorsal on the median and halves of the adjacent rows. The first row of scales much lighter than the ground color above, usually greenish or yellowish, at least the upper half. The color between the stripes may be uniformly black or brown, or olivaceous with two rows of alternating, usually poorly defined, black spots. Regardless of the color of the scales between the stripes, however, there may nearly always be seen, on stretching the skin, two rows of prominent black spots separated by pale interspaces. Along the lateral stripes the interspaces may occasionally be red. The stripes may be yellowish, greenish or bluish, and the laterals when greenish or bluish frequently blend with the first row. The dorsal stripe sometimes wanting. The ventral surface usually pale and free from prominent markings, except for a black spot on each end of the ventrals.

Habits and Habitat: Ruthven (1908, 177-179) has summarized the habits of this species as follows: "The experience of the writer indicates that it is quite generally distributed in the Eastern forest region, for while it is found most commonly in the vicinity of water, it is not uncommon in the clearings, woods, and thickets on the neighboring hills.

"The food consists principally of frogs, toads, salamanders, earthworms, and various insects. Whether or not it feeds to any great extent upon tadpoles and fish is undetermined. Garman (1892, 268) states that they eat these animals, and I have observed them to "capture fish in captivity, but since in the wild state they are not particularly aquatic, the truth of the matter is probably that they capture these forms when they encounter them in small pools, but that this is comparatively seldom. The number and kinds of insects eaten is also a questionable point. It is true that many species are found in the stomachs examined, but, as Surface (1906, 149) says, many of these are 'taken inside of the toads and other batrachians which the garter-snake had eaten.' However, both adults and young

are very fond of earthworms. As other garter-snakes, *sirtalis* apparently does not refuse dead food. Mr. N. A. Wood, of the University of Michigan, reported to the writer, on May 18, 1907, that he saw a specimen of this species swallowing a yellow warbler, which he had observed lying dead in the same place on the preceding day. In the latter part of October, 1907, the writer discovered an individual at Portage Lake, Washtenaw County, Michigan, busily engaged in an attempt to swallow the dried remains of a large green frog (*Rana clamitans*).

"The breeding habits have been commented upon several times, but are as yet only incompletely known. In southern Michigan copulation takes place in April, and at this time it is reported on good authority that these snakes often collect in groups, probably owing to the procreative impulse. I have not witnessed this nor can I find any observations on the act of copulation. The latter I have seen but once, and then but imperfectly. It took place on April 21, 1906, between two specimens in captivity. The male in this case lay at full length beside the female, and evidently attempted to excite her by gently rubbing her neck with his snout. He finally threw a fold of his tail across hers, and turning his ventral surface against her side began spasmodic contractions of the abdominal muscles, which were continued from twenty to thirty minutes. Unfortunately the snakes were then disturbed and the observations ceased. They indicate, however, that there may be some interesting courtship reactions to be observed in these snakes.

"The period of parturition extends from the latter part of July to about the middle of September. Both of these dates are only approximate, as definite observations are wanting. The number of young is very variable, the average range in number being probably about 10-30, while as many as 78 have been recorded in a single brood, which is not at all an unusual number, since *parietalis* may have, according to our observations, as many as 73. After birth the young remain for a short time about the mother, but this time is probably limited to a few hours at most. In captivity there is little tendency discernable to stay near the mother, and although we have several times seen a mother and her brood in a wild state, in every case noted, when the mother became alarmed, or for some other reason moved away, the young scattered in all directions, and it is improbable that they ever came together again. The quickness and completeness with which the little snakes disappear when alarmed may partly explain the fable that this snake swallows its young.

"Ditmars (1907, 235-236) gives the following interesting account of the hibernating habits:

"The favorite situations in which to pass the cold months are in soft soil on a slope that faces the south. Here the reptiles burrow down a yard or more. Rocky situations are often selected, and among the clefts and fissures, one opening into another, the snakes are enabled to retire to a considerable depth from the surface.

"It is in the fall that these snakes congregate in large numbers on ground that is suitable for the winter's sleep. Here they sun themselves during the middle of the day, retiring into clefts and burrows during chilly autumn nights. As the nights become colder, their basking periods during the day are shortened, and finally, after the first severe frost, they remain below the ground for the winter. Instinct seemingly attracts them to these places of hibernation, for such spots are usually poor feeding grounds and have been devoid of snakes during the summer months. In spring, the breeding time, the reptiles remain in numbers until the weather has become well settled and the danger of needing good shelter from the cold spells has passed. Then they scatter into the ravines, the thickets, along streams and brooks, until the scene that has abounded with sinuous, crawling life is deserted."

"This account harmonizes very well with the writer's observations in southern Michigan. In the latter region they are found in the autumn on sunny hillsides in the immediate neighborhood of holes, into which they hasten when alarmed, but that they dig these holes themselves yet remains to be proven, nor after the beginning of the period of hibernation do they necessarily 'remain below the ground for the winter,' for if periods of marked moderation in the temperature occur they will come out in December, January, or February. Thus, on January 22, 1906, which was a warm day (60° F.) in a period of very moderate temperature, a collector for the University of Michigan Museum reported seeing a large garter-snake near Grass Lake, Washtenaw County, Michigan, which was undoubtedly this species."

Range: The species has been reported from: Michigan (Sager, 1839, 302; Miles, 1861, 233), Ann Arbor (Smith, 1879, 6), Hudson and Manitou Beach, Lenawee County (Kirsch, 1895, 333), Grosse Isle and Port Huron (Cope, 1900, 1073), Eaton County (Clark, 1902, 194), Porcupine Mountains, Ontonagon County (Ruthven, 1904, 189, 191), Ann Arbor, Olivet, and Antrim, Barry, Kalamazoo, Kent, Mackinac, Montcalm, Ottawa and Van Buren Counties (Clark, 1905, 109), Bessemer, Gogebic County, Isle Royale, Kewee-

naw County, Limestone Mountain, Baraga County, Marquette, Marquette County, Porcupine Mountains, Ontonagon County (Ruthven, 1906, 111-112), Washtenaw County, Kent County, Grosse Isle, Wayne County, Livingston County, Eaton County, Oakland

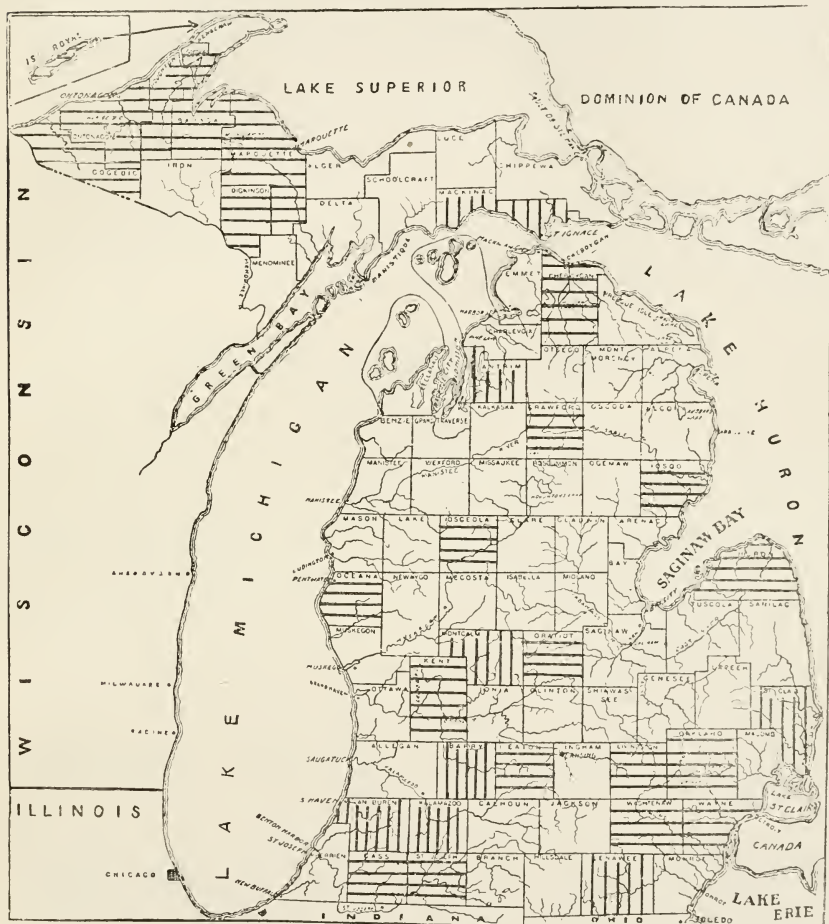


Fig. 43. Distribution of *Thamnophis sirtalis*.
Horizontal ruling, specimens examined; vertical ruling, reports only.

County, Oceana County, Crawford County, Iosco County, Gratiot County, Isle Royale, Lake Superior, Ontonagon County, Gogebic County, Houghton County, Baraga County, Marquette County (Ruthven, 1908, 181), Walnut Lake, Oakland County (Hankinson, 1908, 236), sand region of Huron County (Ruthven, 1911a, 268), Douglas Lake, Cheboygan County (Ruthven, 1911, 115), and Cass

County (Thompson, 1911, 6). Specimens from the following localities have been examined: Alma, Gratiot County, Washtenaw County, Au Sable River, Crawford County, south branch of Au Sable River, Iosco County, Bessemer, Gogebic County, Walnut Lake, Pontiac and Birmingham, Oakland County, Brighton, Iosco, Livingston County, Denton, Wayne County, Isle Royale, Keweenaw County, Limestone Mountain, Baraga County, Marquette, Marquette County, Porcupine Mountains, Ontonagon County, Shelby, Oceana County, Winona, Houghton County, Eaton County, Kent County, Grosse Isle, Wayne County, Douglas Lake, Cheboygan County, Brown Lake, Dickinson County, Charity Island, Saginaw Bay, sand region from Sand Point to Port Austin, Huron County, Cass County, Osceola County, and Dr. A. S. Pearse observed specimens in St. Joseph County in the spring of 1909.

SISTRURUS CATENATUS (Rafinesque).

RATTLESNAKE, MASSAUGER.

(Pl. XIb.)

Crotalus tergeminus, Sager, 1839, 302.

Caudisoma tergimina, Gibbs, 1900, 12-13.

Sistrurus catenatus, Clark, 1902, 194, 1905, 110. Stejneger, 1893, 413. Ruthven, 1911a, 270-271. Thompson, 1911, 107.

Sistrurus catenatus catenatus, Notestein, 1905, 120. Cope, 1900, 1146-1149.

Crotalophorus tergeminus, Baird and Girard, 1853, 14-15. Smith, 1879, 6.

Crotalophorus kirtlandi, Holbrook, 1842, III, 32.

Crotalophorus tergeminus kirtlandi, Smith, 1879, 6. Miles, 1861, 233.

Description: A short thick-bodied snake attaining a length of two and one-half or three feet. Head broad and decidedly triangular in shape, being much swollen through the back part, and terminating in a blunt snout. Generally a slight concavity in the frontal region. Cephalic plates normal in arrangement, but parietal plates small, which together with the broad head and a rather well defined canthus rostralis makes the area covered by the cephalic plates broadly oval in outline. Sides of head high and without or with only a slight concavity in the loreal region. Eye small, situated high up on head, with an elliptical pupil, and over-hung by the supraoculars. A deep pit in the loreal region. Temporal region occupied by four or five rows of smooth scales. Tail terminating in a rattle.

Dorsal scale rows usually 25-23-21-19, frequently 23-21-(19). Supralabials 11-13 in number, separated from the orbit by a row of small scales that is continuous with the postoculars; infralabials usually about 11 to 14. Two preoculars, elongated anteriorly, the upper meeting the posterior nasal scute. Loreal small and trapezoidal in form. Ventrals 134-147; subcaudals 22-30, undivided. Anal plate single.

Ground color above grayish or ash, relieved by several series of deep brown blotches that form cross bands on the tail. Spots of the dorsal series large, and transversely and irregularly oblong in form. Below and alternating with the vertebral row a row of small rounded spots, and below these a series of large blotches transversely oblong and extending to the second row of scales, and alternating with these another series of small spots on the first and second scale rows. Spots of all of the series, with the exception of the row of small rounded blotches exterior to the vertebral series, margined with an inner black and an outer pale yellow line. Dorsal blotches occasionally divided or fused with the upper row of lateral spots. A pair of elongated spots similar to the other dorsal spots in color extend from the cephalic plates to the neck, and another on either side extends backward from the orbit. Inferior yellow margin of the latter well developed between the eye and the angle of the mouth forming a narrow yellow band. Two diverging yellow lines from the pit to the lip. Head dark brown, as the dorsal blotches, but with a light brownish band between the eyes and occasionally light marks on the posterior head plates. Color underneath black irregularly broken up with pale yellow.

Habits and Habitat: The rattle snake, or massanger, as it is generally known, is the only poisonous snake in Michigan; a statement which when generally known should stop the wholesale destruction of the harmless snakes practiced by most persons who come in contact with them. Needless to say this snake should be avoided as it is distinctly venomous, but on the other hand most of the current stories about it must be discredited for it is doubtful if its bite is sufficiently noxious to kill a healthy adult. It is a sluggish snake, slow to bite, and usually gives warning with its rattle before striking. It is thus little to be feared.

It prefers the vicinity of swamps, although not aquatic in its habits, and is becoming yearly more rare in this region. Its extinction is probably due to several causes chief of which is the draining of swamps and the killing of great numbers by farmers. An excellent general account of the habits of the species is given by Hay (1887).

Very few observations have been made on the food habits of this snake. Taylor (1892, 357) writes on the subject as follows: "The contents of the stomachs of this species shows that its food is almost wholly made up of mice and animals of that class. Aside from well known venomous qualities this snake has no bad habits and is decidedly useful. It is said that rats and mice will very soon disappear when the presence of this reptile is known. In at least one instance we have known this statement to be true. It was noticed that rats which a few days previous had been extremely numerous in a certain cellar had wholly disappeared. Within a few days more the mystery was solved by finding a huge rattler in the doorway. These facts fully account for the frequent finding of rattlers around old cellars, buildings, etc., where they go to hunt for their choice food." Ditmars (1907, 438) states that his captive specimens "would take young birds, mice and frogs, and, like the copperhead snake, different kinds of food according to the seasons, a trait probably developed by necessity while in the wild state."

Our observations on the food habits of the species differ from those of Taylor in that frogs form the bulk of the stomach contents in the specimens we have examined. We have also found in two instances snakes (one a rattlesnake) in stomachs examined, and in one case it was evident that the snake eaten had been dead for a considerable time before it was eaten (Ruthven, 1911a, 270).

The young are brought into the world alive, i. e., the eggs are not laid. There are, according to Hay, usually about six young in a brood, and they are about six inches long.

Many erroneous opinions are current concerning this snake. Among these are that the number of rattles indicates the age of an individual, one rattle being added each year. The researches on the growth of the rattle all agree that each ring represents the epidermis shed from the enlarged portion of the tail, in a manner analogous to the general shedding of the skin, the new ring being added at the base each time, thus pushing the string outward. There is some disagreement among observers as to whether or not the two processes always take place at the same time, but the fact is well established that the shedding of the epidermis from the terminal enlargement of the tail and the consequent formation of rattles, like the general shedding of the epidermis, takes place every few (two-five) months, so that several rattles are usually added each year. The reason that so few rings are generally present at one time is that the terminal ones are easily and frequently lost. The number of buttons even on the largest individuals is rarely

more than eight or nine, and the long strings occasionally exhibited as curiosities are in most instances formed by the joining together of several strings.

Another popular fallacy regarding these snakes is that the ex-



Fig. 44. Distribution of *Sistrurus catenatus*.

Horizontal ruling, specimens examined; vertical ruling, reports only.

traction of the fangs renders them harmless. It is true that it does so for a time, but, as is well known to scientists, new fangs soon replace the old ones when the latter are broken off or shed. This is in fact a wise provision of nature, since the long fangs are occasionally broken off by the struggles of the prey.

The writer will not take space to describe further the character-

istics of this snake. A most excellent account may be found in Stejneger's "The Poisonous Snakes of North America" (1893, 413).

Range: The species has been reported from: Michigan (Sager, 1839, 302; Holbrook, 1842, III, 32; Miles, 1861, 233; Stejneger, 1893, 413, Grosse Isle (Baird and Girard, 1853, 14, 15), Ann Arbor (Smith, 1879, 6), New Buffalo, Berrien County (Cope, 1900, 1149), Eaton County (Clark, 1902, 194), Benzonia to Au Sable River (Clark, 1905, 110), Cass County (Thompson, 1911, 107), and Huron County (Ruthven, 1911a, 270-271). We have seen specimens from Alma, Gratiot County, Au Sable River, Oscoda County, Pontiac, Oakland County, various localities in Washtenaw County, Charity Island, Saginaw Bay, Cass County, Stony Island, North Island and Sand Point, Huron County.

ORDER TESTUDINATA. (TURTLES).

As indicated by the key (p. 77) the members of this order are quadrupedal, cuirassed forms with a rounded or longitudinal anal opening. The shell in our species is, with the single exception of the soft-shelled turtle, covered with large dermal plates. Siebenrock (1909) divides the order into four superfamilies only two of which have representatives in Michigan. It is sufficient for our purposes to diagnose the genera and species.

Key to the Genera and Species of Michigan Turtles.

- a¹. Carapace covered by leathery skin, and without horny epidermal plates *Platypeltis spinifera*, p. 129.
- a². Carapace rigid and covered with horny epidermal plates.
 - b¹. Plastron narrow, not nearly filling the opening of the carapace.
 - c¹. Bridge long and narrow. Tail long and furnished above with a median row of large horny tubercles. Marginal scutes 25.... *Chelydra serpentina*, p. 133.
 - c². Bridge short and rather wide. Tail in males with a terminal nail, and without a median dorsal row of tubercles. Marginal scutes 23..... *Kinosternon odoratum*, p. 137.
 - b². Plastron nearly or quite filling the opening of the carapace. Marginal plates 25.
 - c¹. Parts of plastron immovably attached to each other and to the carapace.
 - d¹. Carapace smoothly rounded, i. e., with no median dorsal keel.

- e¹. A sharp tooth on either side of the notch at the symphysis of the upper jaws. Carapace without round, bright orange spots, *Chrysemys*.
- f¹. Vertebral and costal scutes unicolored except for a yellow margin. A relatively small plastral blotch along the median line.....*C. cinerea*, p. 141.
- f². Vertebral and costal scutes marked with irregular pale-yellow lines. A large blotch covering most of the plastron*C. bellii*, p. 143.
- e². No teeth bounding the notch at the anterior end of the upper jaws. Carapace marked with numerous, round, bright orange spots.*Clemmys guttata*, p. 147.
- d². Carapace with a strong median keel.....*Graptemys geographica*, p. 150.
- e². Plastron with a transverse hinge, and movably attached to the carapace.
- d¹. Upper jaw notched in front. Carapace long and depressed.....*Emydoidea blandingii*, p. 153.
- d². Upper jaw produced downward at the symphysis to form a hook. Carapace short and high....*Terrapene carolina*, p. 155.

PLATYPELTIS SPINIFERA (LeSueur).

SOFT-SHELLED TURTLE.

(Pls. VII, XI a)

Aspidoonectes spinifer, Smith, 1879, 7. Clark, 1902, 193; 1905, 110. Miles, 1861, 233. Agassiz, 1857, 404-405.

Trionyx spiniferus, Thompson, 1911, 107.

Description: Body broad and very flat. Carapace and plastron not covered with epidermal plates, but by a soft and leathery skin, the margins of the carapace bending freely at the edges. Head tapering to the snout which is much produced and flexible. Nostrils separated by a septum, and each with a papilla projecting into it from the septum. A low obtuse keel along the middle of the back. A series of spines along the anterior edge of the carapace, in the adults; the entire upper surface of the carapace covered with small tubercles. Feet broad and fully webbed.

Color of carapace olive or light brown, the margin yellow. Near the margin is a narrow, broken line of black. In young specimens there are on the carapace numerous spots somewhat darker than the ground color and each surrounded by a broad, black ring. These spots become smaller and entirely black toward the margin of the carapace, and are obscure in old individuals. Plastron immaculate white or pale yellow. Limbs olive spotted with black. A pair of black lines on the snout, each of which at the base of the latter become two diverging black lines separated by yellow, and pass through the eye onto the neck.

Habits and Habitat: In southern Michigan the soft-shelled turtle occurs rather commonly in the rivers and lakes which have a soft muddy bottom. They are not commonly seen, as they seldom leave the water, and owing to the fact that the color of the carapace harmonizes well with the color of the bottom. When surprised, they are rapid swimmers and easily elude capture. The larger individuals should be handled with care as the lip-like folds of skin cover sharp-edged mandibles that are capable of inflicting considerable injury.

Newman's (1906, 126 *et seq.*) observations on the habits of the soft-shelled turtle at Lake Maxinkuckee, Indiana, are the most comprehensive that have been made and are largely the basis of the following very brief account.

They appear early in April (or in the latter part of March), from their hibernation, and soon begin to feed actively. In food habits it "is voracious and carnivorous, feeding principally upon crayfish and the larvae of large insects. From the vantage ground of a high bank it was possible on still days to observe individuals as they captured their prey. They crawl or swim along the bottom, thrusting their snout under stones and into masses of aquatic vegetation, occasionally snapping up a crayfish or larvae that they have succeeded in dislodging. They do not tear up their food, but swallow it whole, using the fore-feet to assist in forcing it down.

"The stomachs of three specimens, opened during the latter part of June, contained the following:

1. A large female contained nine medium sized crayfish, only slightly digested.
2. A medium sized female contained four crayfish and twenty-two dragon-fly larvae.
3. A large male contained nine dragon-fly larvae and a few plant buds, probably taken by accident when snapping up larvae."

Surface (1908, 123) has recorded the following observations on

the food habits: "Unfortunately, only two of the Soft-shelled Turtles available for examination contained food, although a greater number were examined and found to be empty. Of these neither had eaten any vegetable matter, but both contained Crayfish, which are common inhabitants of streams they frequent, and are doubtless among the chief elements of their food. In devouring Crayfish (or Crawfish), any creature is objectionable from the fact that it is one of the most important foods of the carnivorous fishes. Hay asserts that 'it feeds on such fishes and reptiles as it can secure.'

"One Soft-shelled Turtle was found to contain fragments of beetles so broken as to be beyond recognition, but indicating the possibility of these creatures feeding upon insects which may be found floating on the water or in damp places frequented by such turtles.

"We take this opportunity to record the fact that we have found the Soft-shelled Turtle feeding upon grains of corn obtained in or near the ponds which they inhabit. A specimen examined by us in Ohio some years ago contained both yellow and red field corn, or Indian corn, to the extent of almost as much corn as would be produced upon two average ears of this plant."

Mating must take place during April or May (Newman) and the nesting period extends from about the middle of June to the middle of July. Newman states that "The character of the soil seems to be immaterial so long as it is near the water's edge. Nests were found in clay so hard packed that one could scarcely break it with the fingers. One nest was made in a rock pile, the eggs being dropped into crevices between the rocks, and sand packed around them. Several nests were made among the smaller roots of a tree growing on the sandy beach, the eggs being deposited between and under the roots in a very irregular fashion. The majority of nests, however, were found in the soft beach sand over six feet from the water."

The same writer briefly describes the nest building as follows: "A warm sunshiny day. Place: the 'old road' about ten feet from the water's edge and concealed from view on one side by tall grass. A large female *Aspidonectes* has just escaped from the grass and is commencing to make a nest. No time is lost in selecting a spot. She scratches out footholds for the forefeet and begins to excavate with the hindfeet, using right and left alternately with a circular gouging movement. As the hole becomes deeper it is generally necessary for her to give a more nearly perpendicular thrust with the hindfeet.

"In less than forty minutes the nest is completed and she has commenced to lay her eggs, letting the tail down into the narrow hole as far as possible. After depositing several eggs she arranges them with the hindfeet and then rakes in some earth previously wet



Fig. 45. Distribution of *Platypheltis spinifera*.

Horizontal ruling, specimens examined; vertical ruling, reports only.

up with water from the accessory bladders. The earth is gently packed in before any more eggs are laid. The remainder of the eggs are deposited and the hole is filled up with earth and tramped down quite firmly with the knuckles of the hind feet, right and left feet being used alternately. This treading movement continues for some minutes and seems to be quite thorough. Al-

though not in any way disturbed, the tortoise left without attempting to cover up the traces of scratching feet, and anyone who is familiar with the appearance of a tortoise nest would have no difficulty in detecting this one. At 12:25 she turned and started for the water but was captured with a landing net. The nest was examined and found to be flask-shaped with a narrow neck only an inch and a half in diameter. The depth of the nest was a trifle over six inches and the diameter at the bottom about three inches. The nest contained eighteen rather large spherical eggs of a delicate pink color and with a very thin brittle shell."

After the breeding season is over they spend their time in the water, and as the cold weather comes on, bury themselves in the mud and sand of the bottom where they remain until the following spring.

The soft shelled turtle is highly valued as food, the flesh being delicate and of excellent flavor. Individuals attain a large size, and are rather readily shot or caught with a hook and line.

Range: The species has been reported from: Michigan (Agassiz, 1857, 404-405); "Southern half of the Lower Peninsula. It is frequently met with as far north as Genesee County, and in the streams of the eastern as well as the western slope of the state" (Miles, 1861, p. 233), Ann Arbor (Smith, 1879, p. 7), Eaton County (Clark, 1902, p. 193); Ann Arbor, Brookfield, Olivet; and Allegan, Kalamazoo, Montcalm and Van Buren Counties (Clark, 1905, p. 110), and Cass County (Thompson, 1911, 107). The writer has seen specimens from: Ann Arbor and Portage Lake, Washtenaw County, White Pigeon, St. Joseph County, Cass County, Kalamazoo County and Allegan County.

CHELYDRA SERPENTINA (Linnaeus).

SNAPPING TURTLE.

(Pl. VI.)

Chelydra serpentina, Sager, 1839, 301. Smith, 1879, 7. Clark, 1902, 193; 1905, 110. Kirsch, 1895, 333. Miles, 1861, 232. Hankinson, 1908, 236. Thompson, 1911, 107. Ruthven, 1911a, 271.

Description: Carapace rigid, covered with horny plates, broadly oval in outline, rather depressed and serrated behind. There are three moderate keels on the carapace, one median and two lateral, very prominent in the young, less so in old individuals, the keels tuberculated, the tubercles with radiating edges. Plastron small,

leaving most of the body exposed, bridge narrow. Tail long and tapering. Under surface covered with large scales, the upper surface furnished with a row of large horny tubercles; other smaller tubercles on the upper surface of the tail. Head large and flattened above, and with rather conspicuous bony ridges; snout rather pointed; both jaws terminating in a hook. Large, transverse, sharp-edged scales on the anterior part of the fore leg. Skin wrinkled and covered with prominent warts.

The color of the carapace may be very dark olive, brown or black. Upper parts of head, neck, limbs and tail brown or black, the tips of the warts and various lines on the head frequently yellow or brown. Plastron and under surface generally mostly dull yellow.

Habits and Habitat: This is the largest turtle native to Michigan. True (1893, 153) gives the maximum weight as twenty or thirty pounds. It is extremely pugnacious in disposition, and uses its sharp and powerful jaws upon slight provocation. Large individuals are to be handled carefully, as their powerful, keen-edged jaws are capable of inflicting a severe injury.

Snapping turtles prefer the quiet water habitats, such as lakes, ponds and the pools of sluggish streams. They frequently lie partly embedded in the mud of the bottom, snapping at their prey as it comes within reach; in this habitat they are rendered more inconspicuous by the mat of algae that often grows on the shell. According to Newman (1906, 150), they may also stalk their prey. They are carnivorous, and, according to Garman (1893, 245), "their food consists of all manner of small animals, such as fishes, frogs, reptiles, and young water birds." Hay (1892a, 558) states that "a large specimen that I dissected had in its intestine the feathers and partially digested bones of a full grown robin. The wing and tail feathers filled up the intestine. Its excrement contained the remains of a crayfish."

Numerous other authors mention the food of this turtle but the observations of Surface, who has published the following table, are the most exact.

FOOD CHART OF SNAPPING TURTLE (*C. serpentina*).*

(Number with food, 19).

	No.	Per cent.
Vegetation.....	5	26
Algae (low water plants).....	2	10.5
Seeds, undetermined.....	1	5.2
Leaves, undetermined.....	2	10.5
Apple seeds.....	1	5.2
Skunk Cabbage (<i>Symplocarpus foetida</i>) leaves.....	1	5.2
Grass.....	3	15.7
Animal Matter.....	19	100
Mollusca (Snails and Slugs).....	7	36.8
Snails (<i>Helix</i>).....	4	21.1
Pond Snails.....	2	10.5
Slugs.....	1	5.2
Crustacea, <i>Cambarus</i> sp. (Crayfish).....	12	63.1
Insecta.....	9	47.3
Undetermined Insects.....	2	10.5
Hemiptera (Bugs).....	1	5.2
Corisidae, <i>Corisa</i> sp. (Water Bugs).....	1	5.2
Pentatomidae (Stink Bugs).....	1	5.2
Diptera (Flies).....	3	15.7
Larvae.....	2	10.5
Stratiomyiid (Fly) Larva.....	1	5.2
Coleoptera (Beetles).....	7	36.8
Undetermined.....	5	26.3
Water Beetle larva.....	1	5.2
Hydrophilidae, Water Scavengers.....	1	5.2
Dytiscidae, Diving beetles.....	1	5.2
Gyrinidae, Whirligig Beetles.....	1	5.2
Vertebrata (Vertebrates).....	7	36.8
Undetermined species (Fish).....	2	10.5
Pisces (fishes).....	2	10.5
Undetermined fish.....	1	5.2
Catostomidae (Suckers).....	1	5.2
Batrachia (Frogs, etc.), <i>Rana</i> sp.....	1	5.2
Ophidia (Serpents).....	2	10.5
Aves (Birds).....	1	5.2
Mammalia (Mammals).....	4	21.1
Undetermined.....	1	5.2
Muridae (Mice).....	2	10.5
Leporidae (Rabbits), <i>Lepus</i> sp.....	1	5.2

*From Surface (1908, 128-129.)

Captive specimens will feed upon pieces of meat or the bodies of mammals and birds. They grasp the food, pull it under the water, and swallow it, or, if too large, tear it to pieces by seizing it firmly in the mouth and clawing it with the forefeet.

On land a snapping turtle is a curious sight, as it walks with the body well elevated on the legs. If brought to bay at this time they do not retire into their shells, but, raising themselves still higher on their limbs, open their jaws and lunge forward at the offender with a force that often destroys their equilibrium and causes them to fall forward.

Newman (1906, 150-151) records the following notes on the breeding habits: "Only in one instance have I observed the female *Chelydra* during the nesting process. On this occasion the nest was more than half completed when I first caught sight of her. Although she stopped work and showed signs of preparing for a retreat, she concluded the filling-in process in a somewhat slovenly

were thirty-three eggs scattered irregularly in a double layer. On the whole it was a decidedly untidy and primitive sort of nest.

"At about the same time of the month (June 15) several half-finished nests were found in the same railway embankment and all had the same general characteristics as the one described. I am told by the engineers on the railroad that the females are often seen at work and that they leave precipitately on the approach of the early train.

"The eggs are spherical with one hemisphere white and the other pinkish. The shell is very tough, so that the eggs, if thrown on hard ground, will rebound several inches without breaking. The eggs laid on June fifteenth hatched during the last week in August."

The flesh of the snapping turtle is usually esteemed as food, by the people in localities where the species is found. True (1893, 154) states that "The snapping turtle is regularly seen in spring in the markets of Washington, dressed for cooking, that is, having the under part of the shell and the entrails removed." The eggs are also often eaten.

Range: The species has been reported from: Michigan (Sager, 1839, 301; Miles, 1861, 232), Ann Arbor (Smith, 1879, 7), Hudson and St. Joseph River (Kirsch, 1895, 333), Eaton County (Clark, 1902, 193), Ann Arbor, Olivet, and Barry, Kalamazoo, Kent, Montcalm, Ottawa, St. Joseph and Van Buren Counties (Clark, 1905, 110), Walnut Lake, Oakland County (Hankinson, 1908, 236), Huron County (Ruthven, 1911a, 271), and Cass County (Thompson, 1911, 107).

Specimens have been examined from Washtenaw County, Oakland County, Brown Lake and the falls of the Sturgeon, Dickinson County, Alma, Gratiot County, Charity Islands, Saginaw Bay, Cass County, in Turtle Bay (Sand Point) and in lower part of Pigeon River in Huron County, and Kalamazoo County.

KINOSTERNON ODORATUM (Daudin).

MUSK TURTLE.

(Pl. VII.)

Emys pennsylvanica, Sager, 1859, 301.

Aromochelys odoratus, Smith, 1879, 7. Clark, 1902, 193, 1905, 110. Miles, 1861, 232. Hankinson, 1908, 236. Thompson, 1911, 107.

Description: Carapace rigid, covered with horny plates, rather

narrowly oval in outline, and considerably arched. Young specimens have a prominent keel, but this becomes obscure with age. Plastron very narrow and short, not nearly filling the opening of the carapace, rounded anteriorly, emarginate posteriorly, the anterior part slightly movable on a transverse hinge between the pectoral and abdominal scutes. All of the plastral scutes in the adults separated by areas of skin. Head large; snout tapering and conical. Skin soft and everywhere provided with fleshy papillae, those on the neck in rows, and two to four elongated ones on the chin and two on the anterior part of the throat. Several long curved scales on the anterior side of the foreleg near the foot, and several on the heel.

The color of the carapace in young specimens is dull olive or brown; in old specimens it is blackish brown. The plastron varies from dark yellow to brownish black. Skin dark greenish olive to dark olive brown, marbled with light olive or yellowish olive. Two yellowish lines extend backward from the snout, one passing below and the other above the eye and ear.

Habits and Habitat: The musk turtle is quite aquatic in habits, being found most commonly on the bottom in ponds and lakes. The carapace is very often covered with a thick growth of algae, so that it is difficult to detect when lying in a patch of aquatic vegetation.

Hay (1892a, 562) states that "They lay their eggs on shores in holes that they have dug in the sand with their hind feet. The eggs are from three to five in number, of an elongated elliptical shape, a little more than an inch long, and have a hard, smooth shell." Newman (1906, 147-148) records the following notes on the breeding habits: "On only one occasion did I have the good fortune to observe *Aromochelys* in the process of nesting. When I first encountered the little tortoise she was digging in some soft soil, using all four feet and her snout. On my approach she abandoned her work and wandered about for fully an hour trying different places. Finally she selected for nesting a decayed stump that had rotted down level with the ground. She dug with fore-feet and hind-feet a shallow hole about two inches wide and of about the same depth, and deposited two eggs therein. After covering these eggs with the excavated debris, she went her way. The form and workmanship of this little nest were of an inferior order as compared with those of other species of tortoise I have observed.

"Specimens were captured on land with eggs in the oviducts, ready to be laid, on the following dates: June 11, 16, 20, 22, 23,

and 25. In no case did I find more than three eggs in the oviducts. These were elliptical in form and nearly as large as the eggs of *Chrysemys*. The shell is hard and of a china-like consistency, brittle but capable of withstanding considerable pressure."



Fig. 47. Distribution of *Kinosternon odoratum*.
Horizontal ruling, specimens examined; vertical ruling, reports only.

The same writer (1906, 146-147) records the following notes on the food habits: "I have caught them at dusk, crawling about in the grass and have seen them catching and eating slugs" (p. 147); "They are the scavengers of the lake, feeding on all sorts of material, from dead molluscs to kitchen refuse. They refuse nothing that could be construed as edible. If food is placed in the midst of

a group, they fight over it like so many puppies over a rag, pulling and jerking to the best of their ability." "Their appetite is insatiable and indiscriminate. On one occasion I put a living rat in an aquarium containing several musk tortoises. Almost immediately three of them seized it by the feet and pulled it under, thus drowning it. Before it had ceased to struggle they proceeded to disembowl it and succeeded in making a fairly good skeleton of it in a few hours" (p. 147).

Surface (1908, 138) has tabulated the food found in the stomachs of a number of specimens as follows:

	No.	Per cent.
Mollusca.....	2	50
Snails.....	2	50
Insecta.....	3	75
Orthoptera (Crickets, Grasshoppers).....	1	25
<i>Gryllus pennsylvanicus</i>	1	25
Lepidoptera, (Moths, etc.).....	2	50
Larvae.....	2	50
Coleoptera, (Beetles).....	2	50
Undetermined fragments.....	1	25
Carabidae—Undet., (Ground Beetles).....	1	25

When captured the musk turtles emit a strong odor (not especially disagreeable), open their jaws widely, and hiss, but they seldom bite and then with little effect.

Range: The species has been reported from: Michigan (Sager, 1839, 301; Miles, 1861, 232; Smith, 1879, 7), Eaton County (Clark, 1902, 193), Ann Arbor, Olivet, and Barry, Kalamazoo, Montcalm and Van Buren Counties (Clark, 1905, 110), Cass County (Thompson, 1911, 107), and Walnut Lake, Oakland County (Hankinson, 1908, 236). The writer has seen specimens from the following localities: Washtenaw County, Walnut Lake, Oakland County, Cass County, and Miss Crystal Thompson saw one in the Kalamazoo River, Calhoun County, in September, 1911.

CHRYSEMYS CINEREA (Bonnaterre).

WESTERN PAINTED TURTLE.

(Pl. VII.)

Emys picta, Sager, 1839, 301.*Chrysemys marginata*, Agassiz, 1857, 439. Smith, 1879, 7. Clark, 1902, 193; 1905, 110. Miles, 1861, 233. Hankinson, 1908, 236-237.*Chrysemys cinerea*, Ruthven, 1911, 115; 1911a, 271. Thompson, 1911, 107.

Description: Carapace rigid, covered with horny plates, broad and depressed, flaring considerably posteriorly, and without trace of keel. Plastron broad and flat, immovably attached to the carapace and not hinged. Head moderate in size; upper jaw with a distinct notch in front, and a sharp tooth on either side of the notch.

Carapace dark olive, brown or black. The scutes narrowly margined with dull yellow. Marginal plates prominently marked with red as follows: on the upper surface narrow crescentic bands often surrounding (especially anteriorly) a wider vertical band that is median in position and an extension of a similarly situated band on the lower surface. The last named band is the principal mark on the lower surface and is there surrounded, on the inner end and on the sides, by the black ground color. There may be other light marks on the lower surface, but these are rarely prominent; the most conspicuous and perhaps frequent one is a spot or short band in the black areas between the central bands. (Cf. description of *C. bellii*.) Plastron yellowish with a large central patch of dusky, which is, however, never as large as in *C. bellii* (Figs. 50-51). Head black striped with yellow; neck and limbs striped with red.

Habits and Habitat: This is the common turtle of southern Michigan. It may be seen along most of the streams or about the borders of ponds and lakes. If the habitat is approached cautiously they may be seen basking on logs, muskrat houses, etc., but they are easily alarmed, and quickly scramble off into the water and bury themselves in the mud and vegetation of the bottom. If undisturbed they soon come to the surface again and thrust their pointed black snouts out of the water.

Hay (1892a, 572) states that the food "probably consists of insects, tadpoles and other feeble small animals." Newman (1906, 144) writes that he has observed individuals "feeding on dead fish.

dead clams, decaying tortoises, worms, meat, and aquatic insects. They even capture the soft and defenseless young of *Aspidonectes* [*Platypeltis*]." The same writer describes the egg-laying as follows: "The method of nest-making is essentially like that de-

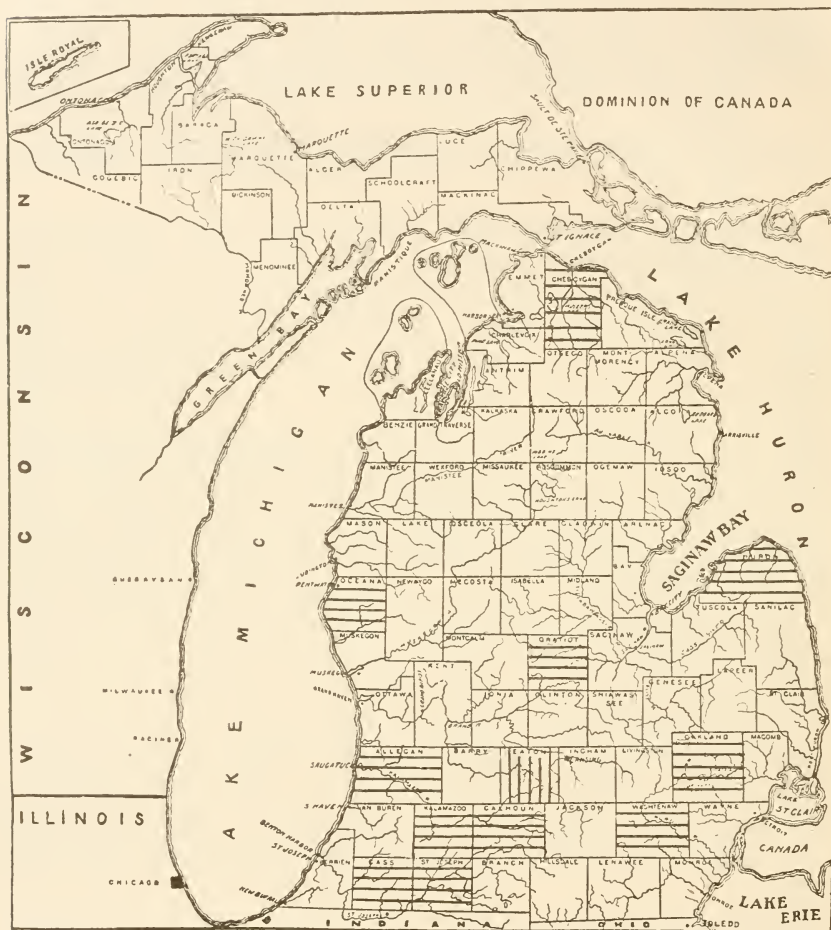


Fig. 48. Distribution of *Chrysemys cinerea*.

Horizontal ruling, specimens examined; vertical ruling, reports only.

scribed for *Graptemys*, but the flask-like enlargement is much less pronounced. This may be due to the smaller number of eggs laid and the consequent economy of space. The nesting season is about the same as for *Graptemys* and the choice of nesting places about the same. They lay only four to eight eggs that are strikingly like those of *Graptemys* in color, shape and character of shell. In size, however, they are somewhat smaller.

"Like *Graptemys*, the broods are sometimes belated in hatching, so that a forced hibernation of embryos results. Many just-hatched young were found during the months of May and June."

Range: The species has been reported from: Michigan (Sager, 1839, 301; Agassiz, 1857, 439; Miles, 1861, 233), Ann Arbor (Smith, 1879, 7), Eaton County (Clark, 1902, 193), Porcupine Mountains, Ontonagon County (Ruthven, 1904, 191), Ann Arbor, Marquette, Olivet, Porcupine Mountains (Clark, 1905, 110), Stony and North Islands and Sand Point, Pigeon River, Rush Lake, Huron County (Ruthven, 1911a, 271), Marquette, Porcupine Mountains, Ontonagon County (Ruthven, 1906, 112), Douglas Lake, Cheboygan County (Ruthven, 1911, 115), Cass County (Thompson, 1911, 107), Walnut Lake, Oakland County (Hankinson, 1908, 236-237). The northern peninsula records probably all refer to *C. bellii* and are not recorded on the map. The writer has seen specimens from Washtenaw, Oceana County, St. Joseph County, Monroe and Douglas Lakes, Cheboygan County, Cass County, Alma, Gratiot County, Stony and North Islands, Sand Point, Pigeon River at Caseville, and Rush Lake, Huron County, Allegan County, Kalamazoo County, Calhoun County, and Mr. N. A. Wood observed specimens on Charity Island in 1910.

CHRYSEMYYS BELLII Gray.

BELL'S TURTLE.

Chrysemys bellii, Ruthven, 1909, 117.

Chrysemys marginata bellii, Ruthven, 1910, 59.

Chrysemys marginata, Ruthven, 1904a, 191; 1906, 34-112.

Description: Structural characters as in *C. cinerea* from which it differs in attaining a somewhat larger size (large individuals reaching a length of six to eight inches as compared with five to six inches in *cinerea*) and in color markings. The yellow borders to the dorsal shields are generally narrow or wanting but are occasionally as wide as in *cinerea*. Costal and vertebral scutes marked with faint, irregular light lines. The prominent markings on the marginals are: above; a median and two lateral pale vertical bands, the median continued on the lower surface and there extended on the outer and inner margins to restrict the intervening black area to a spot with a pale center. These markings may be yellow or red. The dusky markings on the plastron always form a much larger blotch than in *C. cinerea* (Figs. 50-51). This blotch covers a large part of the plastral surface and send out extensions along the sutures.

Habits and Habitat: The habits of this species are probably very similar to those of *C. cinerea*. It is found in similar habitats.

Range. *C. bellii* has been found thus far only in the western part of the northern peninsula. It is a western form that ranges

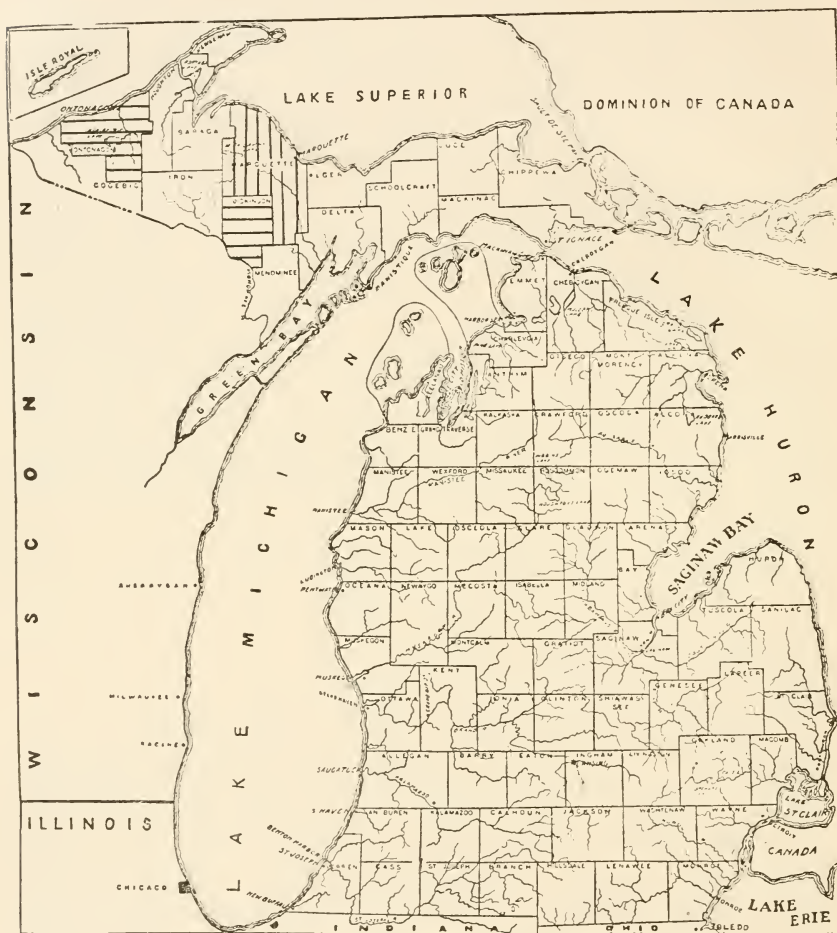


Fig. 49. Distribution of *Chrysemys bellii*.

Horizontal ruling, specimens examined; vertical ruling, reports only.

westward to Oregon. The Michigan localities are: Porcupine Mountains, Ontonagon County, Brown Lake, Norway and Iron Mountain, Dickinson County (Ruthven, 1909, 117; 1910, 59). The Marquette record for *cinerea* (Ruthven, 1906, 112) is probably this form and is so indicated on the map.

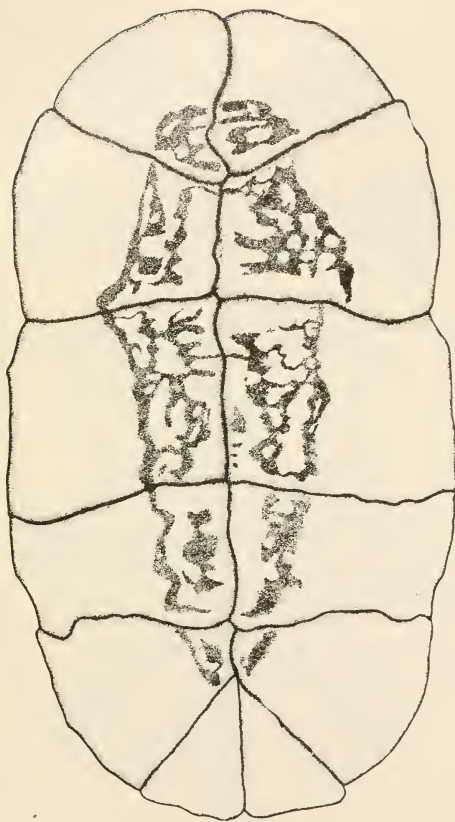


Fig. 50. Plastron of *Chrysemys cinerea*.

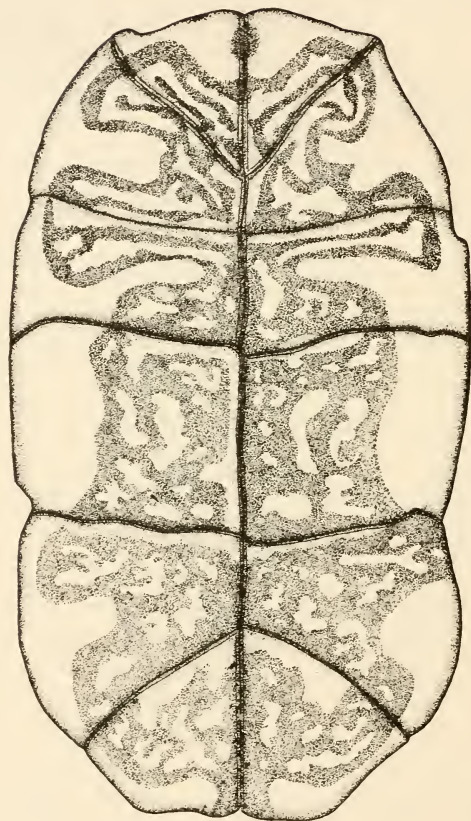


Fig. 51. Plastron of *Chrysemys bellii*.

CLEMMYS GUTTATA (Schneider).

SPECKLED TORTOISE.

(Pl. VII.)

Emys guttata, Sager, 1839, 301.*Nanemys guttatus*, Smith, 1879, 7. Miles, 1861, 233.*Clemmys guttatus*, Clark, 1902, 193; 1905, 110. Thompson, 1911, 107.

Description: Carapace rigid, covered with horny plates, oval in outline and widest behind the middle. Carapace without a keel. Plastron large, without a transverse hinge, and immovably joined to the carapace. Head of moderate size; snout not projecting; upper jaw notched in front.

Carapace black or dark reddish brown with one to several round, bright orange spots on each scute. The plastron is reddish orange and black, the black being limited to large blotches on the ends of the scutes. The head and the upper surface of neck and limbs are black (often washed with red) with orange spots, the under surfaces orange yellow, the throat marbled with darker.

Habits and Habitat: We have no notes on the habits of this turtle in Michigan. Ditmars (1907, 51) has recorded the following observations: "The writer has found many specimens along brooks that here and there spread into thick, grassy spots. It is in this water-grass that the turtles delight to hide, after feeding. The species always feeds under water and, in fact, appears to be unable to swallow unless the head is submerged. The food consists largely of dead fish and the larvae of aquatic insects. Captive specimens will eat the tender leaves of lettuce if these be thrown upon the surface of their tank. It therefore appears probable that they feed upon various water plants as well, while in a wild condition." Holbrook's account differs in some respects from the above. He says (1842, I, 83). "It lives in ponds, brooks and rivers, feeding on such animals as it can seize, as tadpoles, young frogs, etc. It takes to the land frequently in search of food, devouring earthworms, crickets, grasshoppers, etc." Hay (1892a, 577) states that it is less aquatic than most of our turtles but "seems to delight in being in the neighborhood of swamps and sluggish streams, and probably spends the greater part of its time in the water."

The same writer also says "Their food is said to consist of tadpoles, young frogs and other weak animals. On land they devour earthworms, crickets and grasshoppers." Surface (1908, 166-167) has summarized his examination of the stomachs of 27 specimens as follows:

	No.	Per cent.
Vegetation.....	3	11.1
Undetermined leaves.....	1	3.7
Undetermined seeds.....	1	3.7
Gramineae—Grass.....	2	7.4
Animal matter.....	27	100
Annulata, (Worms).....	1	3.7
Mollusca.....	3	11.1
Snails.....	2	7.4
Slugs.....	1	3.7
Crustacea.....	8	29.6
Undetermined spp.....	6	22.6
<i>Gammarus</i> sp., (Fresh Water Shrimps).....	1	3.7
<i>Cambarus</i> sp., (Crayfish).....	1	3.7
Myriapoda, (Millipedes, etc.).....	1	3.7
Arachnida, (Spiders).....	2	7.4
Insecta, (Insects).....	27	100
Undetermined fragments.....	11	40.8
Ephemera, (Mayflies).....	2	7.4
Plecoptera—Perlidae, (Stone Flies).....	3	11.1
Odonata, (Dragon Flies).....	9	33.3
Nymphs.....	8	29.6
Agriionidae, (Damsel Flies).....	1	3.7
Hemiptera, (Bugs).....	3	11.1
Capsidae, (Water Bugs).....	1	3.7
Notonectidae, (Back Swimmers).....	1	3.7
Belostomidae.....	1	3.7
<i>Zuitha puminea</i>	1	3.7
Neuroptera—Sialidae.....	2	7.4
Lepidoptera.....	3	11.1
Undetermined Moth larvae.....	2	7.4
Noctuidae, (Cutworms).....	1	3.7
Coleoptera.....	20	74.0
Undetermined Beetle fragments.....	13	48.1
Carabidae, (Ground Beetles).....	2	7.4
Dytiscidae, (Diving Beetles).....	2	7.4
Chrysomelidae, (Leaf Beetles).....	3	11.1
Undetermined.....	2	7.4
<i>Donacia</i> sp.....	1	3.7
Scarabaeidae.....		
<i>Lachnosterna</i> , (June Bugs).....	1	3.7
<i>Euphoria inda</i> , (Flower Beetles).....	1	3.7
<i>Macrodactylus subspinosus</i> , (Rose Bugs).....	2	7.4
Rhynchophora, (Snout Beetles).....	1	3.7
Diptera, (Flies).....		
Undetermined flies.....	10	37
Tipulidae, (Crane Flies).....	2	7.4
Chironomidae, (Midges).....	1	3.7
Scatophagidae.....	1	3.7
Hymenoptera, (Ants, etc.).....		
Tenthredinidae.....	1	3.7
Ichneumonidae.....	1	3.7
Brachionidae.....	1	3.7
Ants.....	1	3.7

"Their eggs are few in number; never according to Agassiz, exceeding three or four. They are about an inch and a quarter long, and three-quarters in the shorter diameter. The eggs are laid about the 20th of June, in a perpendicular hole dug by the use of the hind legs. After the eggs are deposited the dirt is pushed back over the opening so as to conceal it entirely." (Hay, 1892a, 577-578).

Range: The species has been reported from: Michigan (Sager, 1839, 301), Genesee County, Oakland County, Saginaw Bay (Miles, 1861, 233), Ann Arbor (Smith, 1879, 7), Eaton County (Clark, 1902, 193), Ann Arbor, Olivet, and Barry, Kalamazoo and Van Buren Counties (Clark, 1905, 110), and Cass County (Thompson,

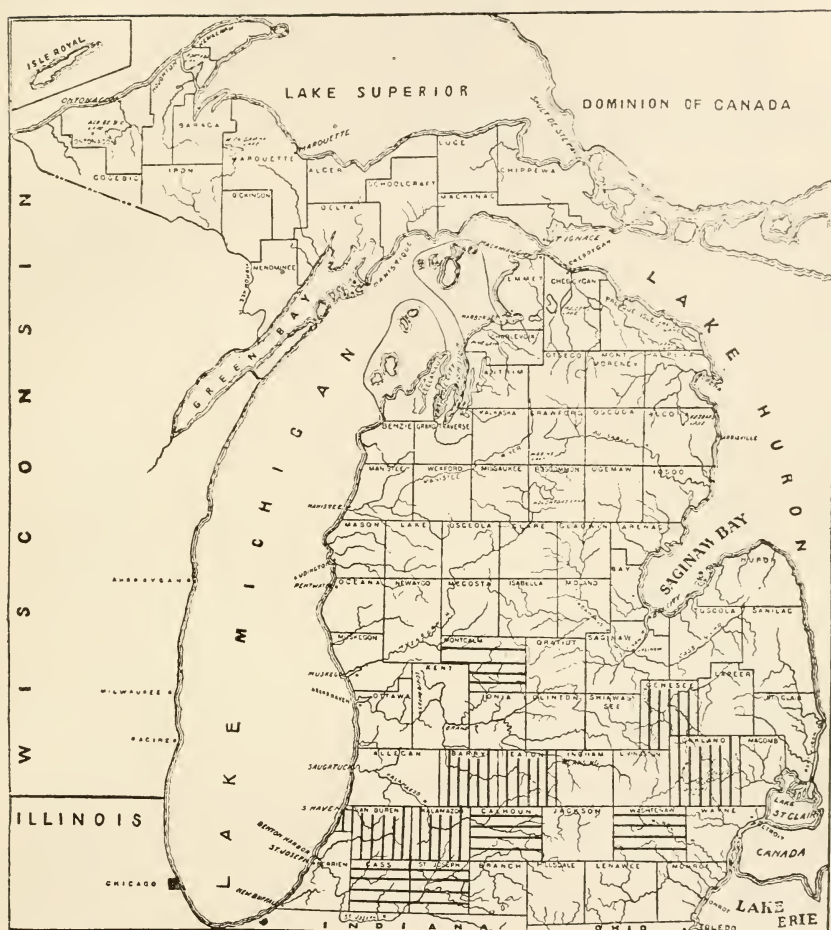


Fig. 52. Distribution of *Clemmys guttata*.
Horizontal ruling, specimens examined; vertical ruling, reports only.

1911, 107). The specimens the writer has seen are from the following localities: Ann Arbor and Manchester, Washtenaw County; Cass County, Calhoun County, St. Joseph County and Montcalm County.

GRAPTEMYS GEOGRAPHICA (La Sueur).

MAP TURTLE.

(Pl. VI.)

Emys geographica, Sager, 1839, 301.*Graptemys geographica*, Agassiz, 1857, 436. Clark, 1902, 193, 1905, 110. Smith, 1879, 7. Miles, 1861, 232.

Description: Carapace rigid, covered with horny plates, depressed and with a distinct, slightly tuberculated keel (much more distinct in the young). Carapace feebly serrated behind. Plastron large, nearly filling the opening of the carapace, immovably united to it, not hinged, and distinctly notched behind. Snout not projecting. Cutting edge of upper jaw somewhat sinuous.

Color of carapace dark olive, covered with a network of greenish-yellow lines (occasionally uniformly dark brown above). Head, neck, limbs and tail dark green to black with numerous longitudinal lines of greenish yellow. A triangular yellow spot behind each eye. Under side of marginal plates pale greenish or yellowish with large blotches consisting of concentric lines of olive and black or brown. Plastron yellow, with brownish bands (frequently absent in old individuals) along the sutures of the scutes.

Habits and Habitat: The map turtle is markedly aquatic, seldom, except during the breeding season, being found on land. In southern Michigan it occurs both in lakes and rivers, but is much more common in the former. According to the observations of Garmen (1891, 237), Hay (1892a, 576), and Newman (1906, 140) its food consists principally of molluscs, and very largely of the heavy shelled forms of the family Viviparidae. The young feed on the thinner shelled ones. Newman writes as follows: "Two methods of feeding prevail. The favorite method seems to be to capture the mollusc when the foot and gills are well out of the shell, to bite off the soft parts and leave the hard shell. To do this the final closure of the jaws must be quite sudden. If they fail to secure the body of the snail in this way they adopt the crushing method. The hard shell is easily crushed between the broad flat jaws and the broken pieces of shell are picked out with the aid of the claws. When in search of food they prowl about the bottom, often underneath the dense vegetation. The heavy growth of *Chara* or *Nitella* is tunneled in every direction with the passageways made by foraging *Graptemys*."

Hay (1892a, 576) states that "After a number had been kept for a few days in a tub there were found in it a large number of the

opercles of such molluscs; and in the intestines of one were the remains of a crayfish, some fish scales, and what appeared to be the cases of some kind of caddisworm. Its broad masticatory surfaces are well fitted for crushing the shells of molluscs." In captivity Ditmars (1907, 44) found that it would eat "chopped fish, meat and mealworms, also earthworms and various softbodied grubs, dragging all its food into the water and devouring it beneath the surface."

A specimen examined by Surface (1908, 141) had only crawfish remains in the stomach.

The breeding habits of Indiana specimens have been rather fully reported by Newman (1906, 140-142): "Graptemys begins to lay very early in June, somewhat earlier than other species observed. The females are apt to wander some distance from the water for nesting, seeming to prefer soft, plowed soil or clear, dry sand away from the beaches. They wander about for hours in search of a suitable place for nesting. One specimen started five nests before she was satisfied with the condition of the soil. Two were rejected on account of the presence of stones and one because the sand caved in too readily. The other two appeared to me to be suitable in every way and I was unable to explain why she abandoned them.

"If one expects to see the first stages of nest-making it behooves him to be astir before sunrise. Over half of the females found nesting were encountered before eight o'clock. They work slowly and seem to prefer the quiet hours of the day, probably because they are less likely to be disturbed.

"Apart from the slowness and deliberateness of their movements, they work much after the fashion adopted by *Aspidonectes*, except that they never work the fore-feet so as to secure foothold.

"The nests are of somewhat smaller dimensions and the flask-shaped expansion is more symmetrically placed, scarcely more bulged on one side than the other. Two layers of eggs are deposited in the flasklike expansion but the last two or three eggs are placed in the narrow neck, the uppermost egg being sometimes only about two inches from the surface.

"It is difficult to frighten them away after they have once decided upon a nesting place. When surprised they stop work but soon resume it and continue it to the end, even while the observer is in plain view. The nest of *Graptemys* is a finished product, all traces of nest-making being obliterated. This is accomplished by dragging the smooth plastron back and forth across the small area that had been disturbed by nesting.

"The eggs are ellipsoidal in shape, of a dull white color, and have a rather soft easily indented shell. The number laid by one female at one time varies from eleven to fourteen.

"The eggs hatch, as a rule, late in August or early in September,



Fig. 53. Distribution of *Graptemys geographica*.
Horizontal ruling, specimens examined; vertical ruling, reports only.

the young burrowing to the surface through the sand. When they emerge they are covered with sand that adheres for some time. Their instinct directs them unerringly toward the water and they frequently have to travel almost incredible distances before reaching the lake or a tributary stream. On two occasions I have found recently hatched *Graptemys*, at a distance of about a quarter of

a mile from the water, traveling steadily and in an approximately correct direction toward the lake. At the observed rate of progress they would reach the lake in about two days.

"For some time I was greatly puzzled by the frequent discovery of newly hatched *Graptemys* during the months of May and June. Farmers in the vicinity frequently plowed up nests of eggs that were nearly ready to hatch.

"These facts have been explained by the observation of occasional specimens nesting during the latter part of July. Eggs laid at that time would have only about five or six weeks of steadily warm weather, in which to develop, and would be retarded by the chilling of the ground in October. Thus the well advanced embryos must pass the winter in a condition of dormancy analogous to that observed in hibernating adults.

"On no occasion have I caught a female nesting whose carapace length was less than nineteen centimeters and whose age was less than fourteen years—according to the age record afforded by the annual growth ring on the scutes."

Hay (1892a, 576) has found sixteen eggs in a large female.

Range: The species has been reported from: Michigan (Sager, 1839, 301; Agassiz, 1857, 436; Miles, 1861, 232), Ann Arbor (Smith, 1879, 7), Eaton County (Clark, 1904, 193), Olivet, and Barry, Kalamazoo, Kent, Montcalm, Ottawa and Van Buren Counties (Clark, 1905, 110). The specimens examined are from: Washtenaw County, Brighton, Livingston County, Pawpaw, Van Buren County, St. Joseph County, Allegan County, Calhoun County, and Kalamazoo County.

EMYDOIDEA BLANDINGII (Holbrook).

BLANDING'S TURTLE.

(Pl. VII.)

Emys mcleagris, Agassiz, 1857, 442. Smith, 1879, 7. Miles, 1861, 233.

Emydoidea blandingi, Clark, 1902, 193, 1905, 110. Hankinson, 1908, 236. Ruthven, 1911a, 271.

Emys blandingii, Thompson, 1911, 107.

Description: Carapace rigid, covered with horny plates; elongated oval in outline, and rather high and convex but not as much so as in the box turtle (*Terrapene carolina*). Plastron large, closing the opening of the carapace and attached to it by a ligament. Plastron divided into two movable lobes, the hinge line between the

abdominal and pectoral scutes. Head broad, snout not projecting and the upper jaw notched in front. The lower jaw with a hooked tip.

The ground color of the carapace is usually black with numerous



Fig. 54. Distribution of *Emydoidea blandingii*.

Horizontal ruling, specimens examined; vertical ruling, reports only.

round or irregularly elongated, pale yellow or light brown spots.

In old individuals the lighter markings may predominate toward the margins of the carapace restricting the black to small irregular blotches. Plastron pale yellow to light brown, the outer end of each scute occupied by a large black or brown blotch. Head and neck black or brown above with numerous small yellowish or olive

spots; the muzzle and sides of the head predominatingly olive. Chin and throat immaculate yellow. Legs olive or light brown with mottlings of black or dark brown.

Habits and Habitat: Little has been recorded on the habits of the Blanding turtle. Ditmars (1907, 57) writes on the subject as follows: "Although fully as agile in the water—in swimming, diving and remaining a considerable time beneath the surface—as the typical pond and river turtles and terrapin, this species often evinces a desire to wander about on land, and while it seldom ventures from wet, marshy areas, prowls about through the undergrowth in search of tender shoots, berries and insect larvae, a character quite in opposition to the feeding habits of the strictly aquatic turtles and terrapins, which are unable to feed unless under the water. Blanding's Turtle feeds with equal readiness upon the ground, or under water. Captive specimens are very fond of lettuce; they also feed voraciously upon earthworms, small fishes, tadpoles and young frogs, actively pursuing these creatures in the water and seizing them by a sudden dart of the head. Well fattened specimens are unable to employ the hinged plastron to but a slight extent and with such individuals the rear lobe is quite useless in covering the hind limbs which bulge from the shell in helpless fashion."

Range: The species has been reported from: Michigan (Agassiz, 1857, 442; Miles, 1861, 233), Ann Arbor (Smith, 1879, 7), Eaton County (Clark, 1902, 193), Ann Arbor, Olivet, and Kalamazoo and Van Buren Counties (Clark, 1905, 110), Sand Point and Stony Island, Huron County (Ruthven, 1911a, 271), Walnut Lake, Oakland County (Hankinson, 1908, 236), and Cass County (Thompson, 1911, 107). The writer has seen specimens from: Washtenaw County, Au Sable River, Oscoda County, Brighton, Livingston County, Walnut Lake, Oakland County, Cass County, Alma, Gratiot County, Sand Point and Stony Island, Huron County, and Mr. N. A. Wood reports seeing one in the pond on Charity Island.

TERRAPENE CAROLINA (Linnaeus).

BOX TURTLE.

(Pl. VII.)

Cistudo clausa, Sager, 1839, 301. Smith, 1879, 7.

Cistula virginea, Agassiz, 1857, 445.

Terrapene carolina, Clark, 1902, 193; 1905, 110. Thompson, 1911, 107.

Description: Carapace rigid and covered with horny plates, broadly oval in outline, high, very convex, and solid. Plastron,

large, closing the opening of the carapace with which it is united by a ligament. Plastron divided into two movable lobes, the hinge line between the abdominal and pectoral scutes. Snout not projecting; the upper jaw drawn down in front to form a beak, the lower jaw turned upward at the tip.

The colors of the carapace are yellow and brown or black. The arrangement is very variable and either the lighter or darker colors may predominate. The head, neck, limbs and tail are brown, spotted with yellow. The plastron is also very variable in coloration. It may be uniformly brown or black, and the brown or black may be spotted with yellow, or the yellow may be the predominating color and the brown or black reduced to irregular blotches.

Habits and Habitat: The box turtle differs from other Michigan turtles in being strictly terrestrial. No notes are available on the habitats preferred by the species in Michigan, but Ditmars (1907, 61) makes the general statement that it is "most abundant in situations where open, grassy spots alternate in sparse thickets. The food consists largely of vegetable matter and berries, though the larvae of insects are eaten as well as earthworms and slugs. During the periods when blackberries ripen many specimens show unmistakable evidence of feasting by their stained mandibles and forefeet."

Holbrook (1842, I, 34) states that it feeds on "insects, crickets, etc., and according to Leconte, on fungous plants, as the *Clavaria*, etc. When in confinement and it can easily be domesticated, it eats readily whatever is offered, as bread, potatoes, apples, etc." Surface (1908, 175-176) has examined stomachs of 40 specimens and tabulated the results as follows:

	No.	Per cent.
Vegetation.....	25	62.5
Cryptogams, (Flowerless Plants).....	7	17.5
Fungi.....		
Undetermined fungi.....	1	2.5
Basidiomycetes.....	1	2.5
Mushrooms.....	1	10
Bryophyta, Moss.....	1	2.5
Phanerogams, (Flowering Plants).....		
Undet.....	4	10
Roots.....	2	5
Buds.....	1	2.5
Leaves.....	5	12.5
Berries.....	3	7.5
Seeds.....	1	2.5
<i>Podophyllum peltatum</i> (May Apple).....	1	2.5
<i>Vitis labrusca</i> (Grapes).....	1	2.5
<i>Prunus</i> sp. (Cherry) seeds.....	1	2.5
<i>Rubus</i> sp. (Blackberry).....	3	7.5
<i>Pyrus</i> sp. (Apple).....	2	5
<i>Osmorhiza</i> sp.....	1	2.5
<i>Pyrola rotundifolia</i>	1	2.5
<i>Physalis</i> sp. (Ground Cherry).....	3	7.5
Gramineae, grass.....	8	20
Bird's Wheat Moss.....	1	2.5
Animal matter.....	32	80
Annulata (Earthworms).....	2	5
Mollusca (Mollusks).....	15	37.5
Snails.....	14	35
Slugs.....	2	5
Crustacea (<i>Cambarus</i> sp.).....	1	2.5
Myriapoda (Millipedes).....	8	20
Insects (Insecta).....	24	60
Undetermined insects.....	7	17.5
Orthoptera (Grasshoppers, etc.).....	7	17.5
Acrididae.....	1	2.5
<i>Melanoplus femur-rubrum</i> (Red-legged G).....	2	5
Gryllidae (Crickets).....	1	2.5
<i>Gryllus pennsylvanicus</i> (Cricket).....	2	5
Locustidae (Long Horned Grasshoppers).....	1	2.5
Hemiptera Pentatomidae (Stink Bugs).....	1	2.5
Lepidoptera (Moths).....	9	22.5
Larvae (Caterpillars).....	7	17.5
Pupae (Chrysalids).....	1	2.5
Notodontidae— <i>Dalana ministra</i>	1	2.5
Noctuidae, larvae (Cut worms).....	3	7.5
Diptera (Flies).....	1	2.5
Coleoptera (Beetles, etc.).....	10	25
Undetermined beetles.....	7	17.5
Larvae of Beetles.....	2	5
Carabidae (Ground Beetles).....		
Undetermined ground beetles.....	2	5
<i>Carabus limbatus</i>	1	2.5
<i>Pterostichus lucublandus</i>	1	2.5
<i>Harpalus caliginosus</i>	1	2.5
Hymenoptera (Ants, etc.).....	1	2.5
Vertebrata (Back-boned Animals).....		
Mammalia, Muridae (Mice).....	1	2.5

The eggs are covered by a thin shell, and are deposited in loose soil. According to Hay (1892a, 581), they number from four to six and are laid about the latter part of June or after.

In winter they burrow into the soil to hibernate, and Ditmars (1907, 62) records one that was found in January, buried to a depth of about two feet.

Range: The species has been reported from: Michigan (Sager, 1839, 301; Agassiz, 1857, 445), Ann Arbor (Smith, 1879, 7), Eaton and Montcalm Counties (Clark, 1902, 193), Barry, Kalamazoo,

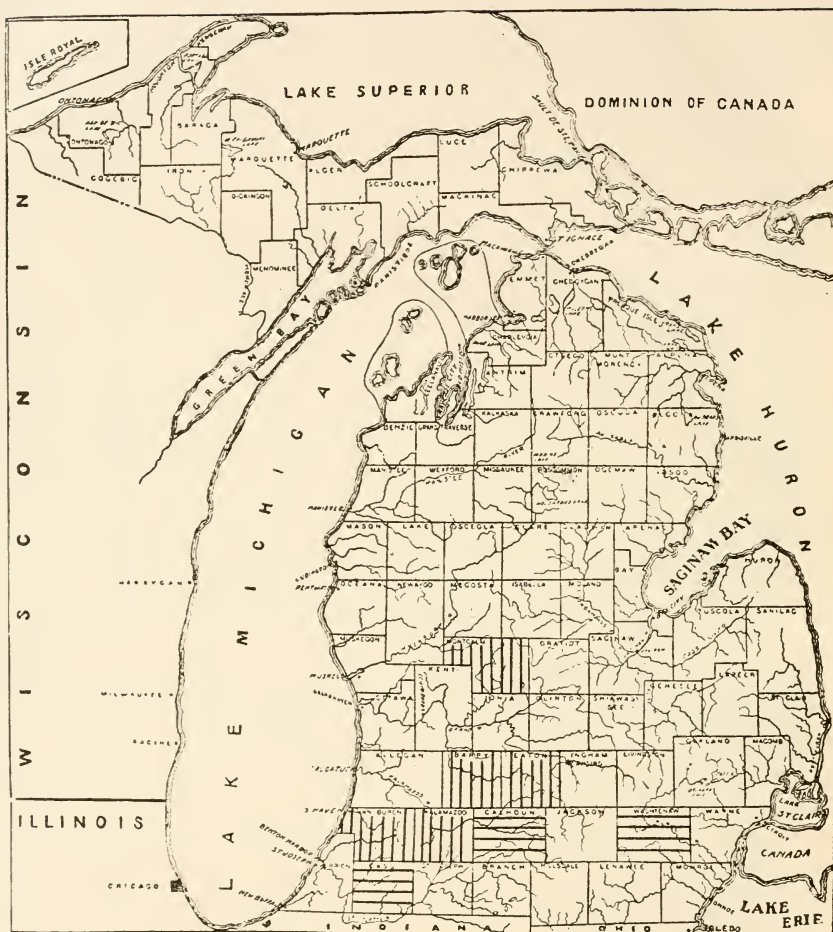


Fig. 55. Distribution of *Terrapene carolina*.
Horizontal ruling, specimens examined; vertical ruling, reports only.

Montcalm and Van Buren Counties (Clark, 1905, 110), and Cass County (Thompson, 1911, 107). The writer has examined specimens from Battle Creek, Calhoun County, Manchester, Washtenaw County, and Cass County.

GLOSSARY.

Abdominal plates. The antepenultimate pair of large scales on the plastron in turtles. (See Fig. 25.)

Alveolar surface. The masticatory surface of the jaws in turtles.

Anal plate. The large scale just in front of the anus in snakes. (See Fig. 23.) The posterior plates on the plastron of a turtle. (Fig. 25.)

Azygous scale. Occurring singly, i. e., unpaired. Applied to the small plate on the median line of the snout in *Heterodon platyrhinus*.

Bridge. The part of the shell which joins the carapace and plastron in turtles.

Canthus rostralis. The ridge from the eye to the tip of the snout that separates the top of the muzzle from the side.

Carapace. The upper shell in turtles. (See Fig. 24.)

Cephalic plates. The large scales on the top of the head in snakes. (See Fig. 22.)

Costal plates. The row of large scales between the marginal and vertebral series on the carapace in turtles. (See Fig. 24.)

Dorsal scales. The scales on the upper surface of the body in snakes. (See Fig. 23.)

Emarginate. Obtusely notched.

Femoral plates. The penultimate pair of scales on the plastron in turtles. (See Fig. 25.)

Frontal. The single large scale on the top of the head, and between the supraoculars, in snakes. (See Fig. 22.)

Gular plate. In turtles, the first plate or pair of plates on the plastron. (See Fig. 25.)

Hinge. A transverse joint in the plastron in some turtles.

Humeral plates. The second pair of scales on the plastron in turtles. (See Fig. 25.)

Internasal plates. The two large scales on top of the head, and between the nasals, in snakes. (See Fig. 22.)

Keel. A ridge.

Labial plates. See upper labials and lower labials.

Loreal plate. The scale on the side of the head, between the nasals and preocular, in snakes. (See Fig. 21.)

Lower labial plates. The row of scales along the margin of the lower jaw in snakes. (See Fig. 21.)

Marginal plates. The scales about the margin of the carapace in turtles. (See Fig. 24.)

Nasal plate or plates. The first one or two plates on the side of the head in snakes. (See Fig. 21.) See also prenasal and postnasal.

Nuchal plate. The small plate in the marginal series at the anterior end of the carapace in turtles. (See Fig. 24.)

Ocular plates. See preocular and postocular plates.

Parietal plates. The pair of large scales on the top of the head, back of the frontal and supraocular plates, in snakes. (See Fig. 22.)

Pectoral plates. The third pair of scutes on the plastron in turtles.

Pit. The opening on the side of the head, between the eye and nostril, in the rattlesnake.

Plastron. The lower shell in turtles. (See Fig. 25.)

Plate. A large scale. Synonymous with scute.

Postnasal plate. The posterior nasal scale, when there are two, in snakes. (See Fig. 21.)

Postocular plates. The series of scales just behind the orbit in snakes. (See Fig. 21.)

Prefrontal plates. The pair of large scales on the top of the head, just in front of the frontal and supraoculars, in snakes. (See Fig. 22.)

Prenasal plate. The anterior nasal scale, when there are two, in snakes. (See Fig. 21.)

Preocular plate or plates. The scale or scales just in front of the orbit in snakes. (See Fig. 21.)

Rattle. The dermal structure on the tail in rattlesnakes.

Rostral plate. The large scale on the end of the snout in snakes.

Scales. Thin horny outgrowths of the skin which overlap to form a more or less complete investment in reptiles. When large known also as plates and scutes.

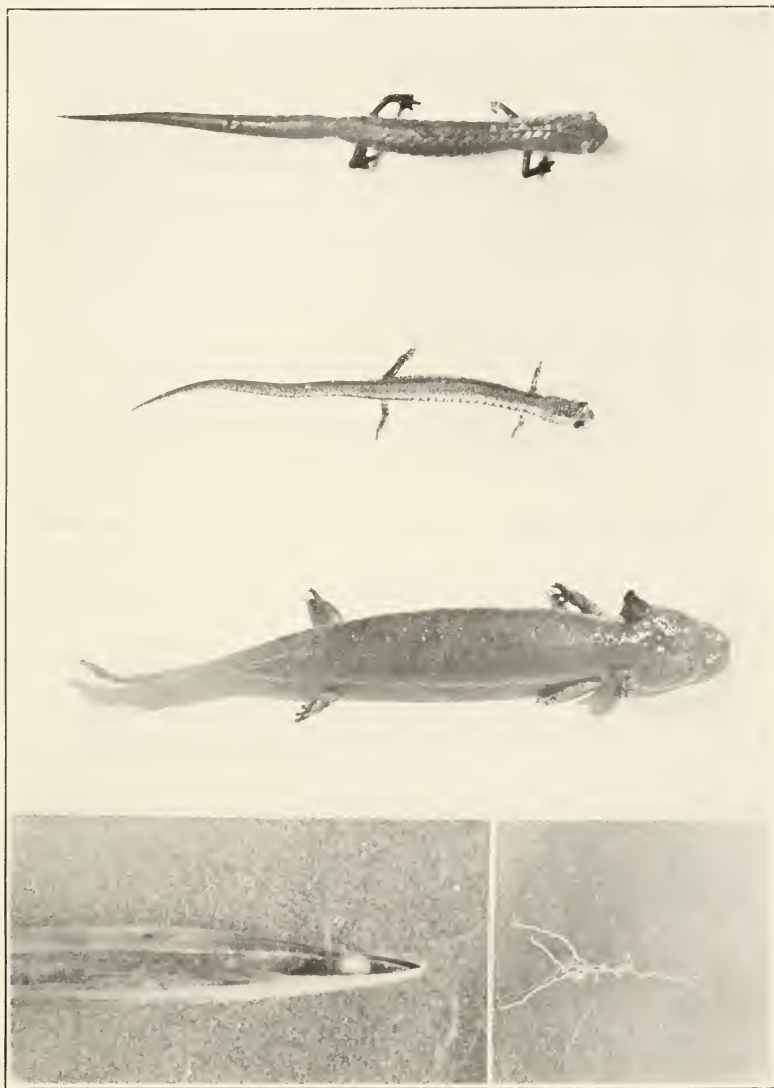
Scale pits. Tiny pores at the apex of the scales in some snakes.

Scute. A large scale. Synonymous with plate.

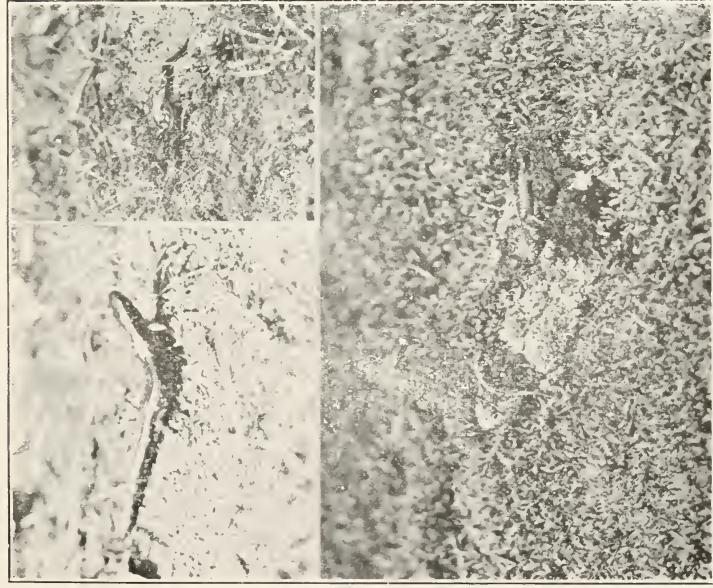
Subcaudal plates. The large scales on the ventral surface of the tail in snakes. (See Fig. 23.)

Supraocular plate. The large scale above each eye in snakes. (See Fig. 22.)

Temporal plates. The scales on the side of the head, behind the postoculars, in snakes. (See Fig. 21.)



HEMIDACTYLIUM SCUTATUM.
PLETHODON ERYTHRONOTUS.
NECTURUS MACULOSUS.
EGGS OF *DIEMICTYLUS VIRIDESCENS.*



A. *AMBYSTOMA JEFFERSONIANUM*, *DIEMICTYLUS VIRIDESCENS*,
AMBYSTOMA TIGRINUM AND *A. PUNCTATUM*.



B. *PLETHODON ERYTHRONOTUS* AND EGGS.



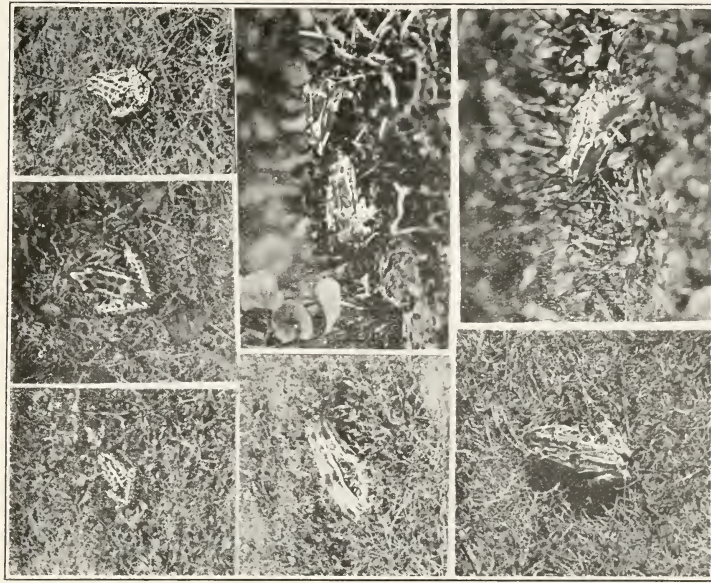
A. Bufo americana; PHOTO TAKEN WHILE THE
TOADS WERE SINGING; NOTE THE EXTENDED VOCAL
POUCH AND CHARACTERISTIC ATTITUDES.



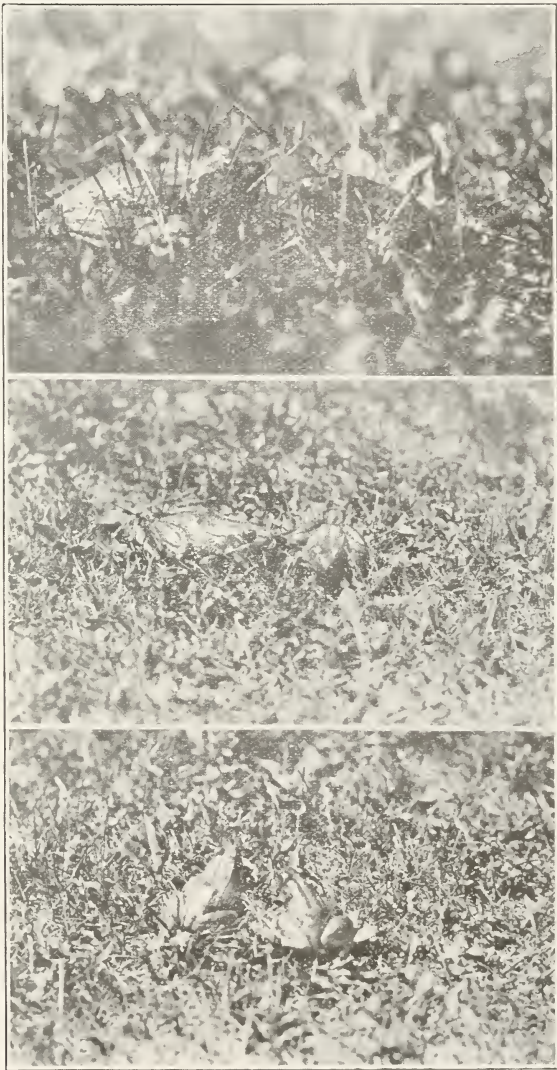
R. Hyla versicolor.
Hyla versicolor. *Hyla pickeringii*.



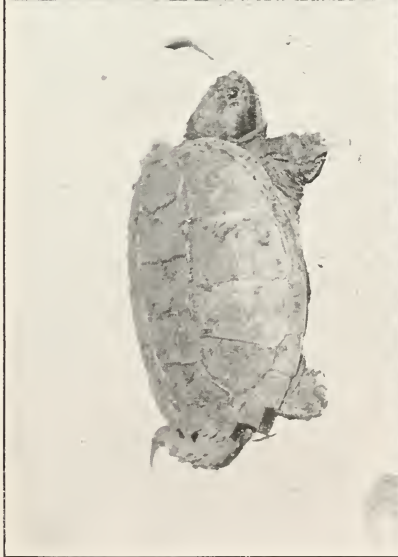
A. *CHOROPHYLLUS NIGRATUS*. (PHOTO BY J. E. REIGLIARD.)
RANA CANTABRIGENSIS.

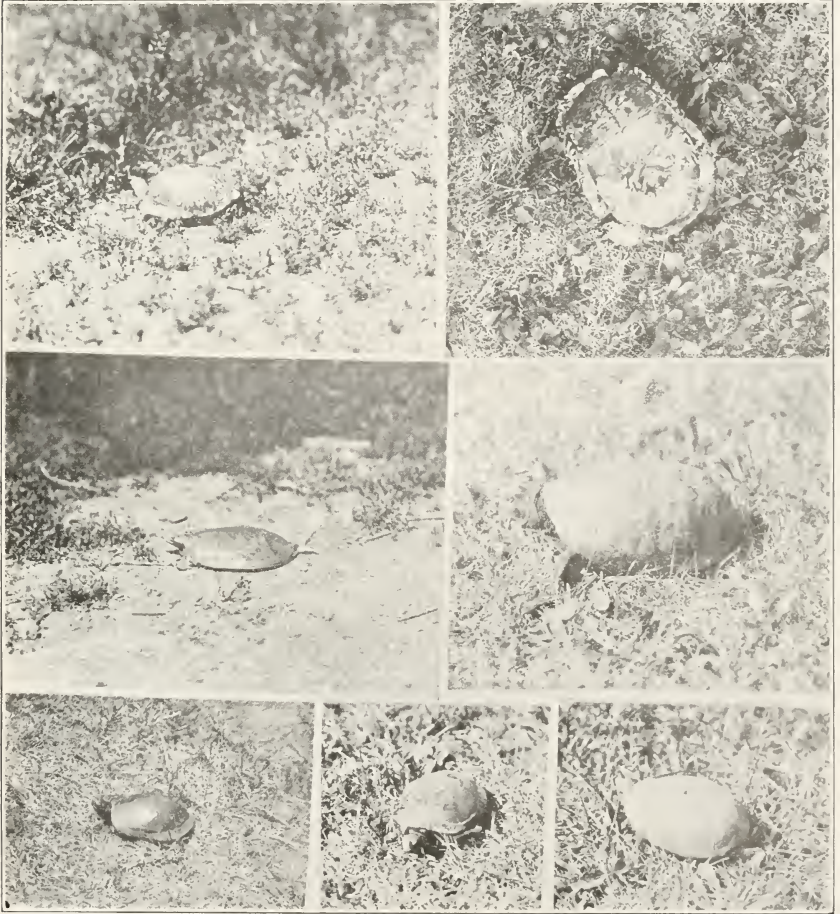


B. *RANA PALUSTRIS*. (TOP ROW.)
RANA PIPIENS.



RANA CLAMITANS.





TERRAPENE CAROLINA, DORSAL AND VENTRAL VIEWS.
PLATYPELTIS SPINIFERA. *EMYDOIDEA BLANDINGII*.
CLEMMYS GUTTATA. *CHRYSEMYS CINEREA*. *KINOSTERNON ODORATUM*.



NEST AND EGGS OF *EUMECES QUINQUILINEATUS*.



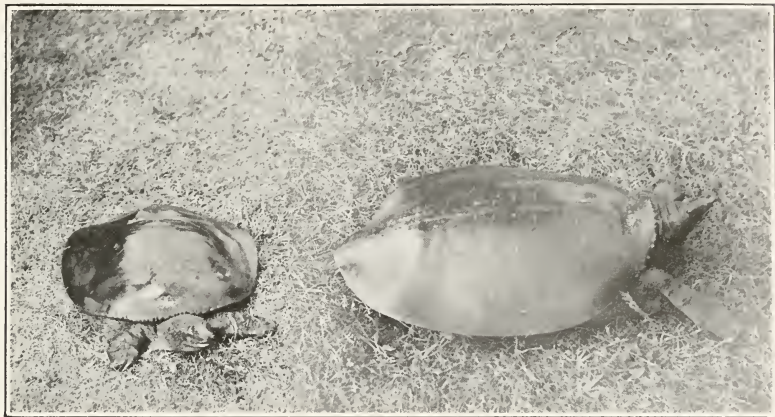
A. *ELAPHE VULPINUS*.



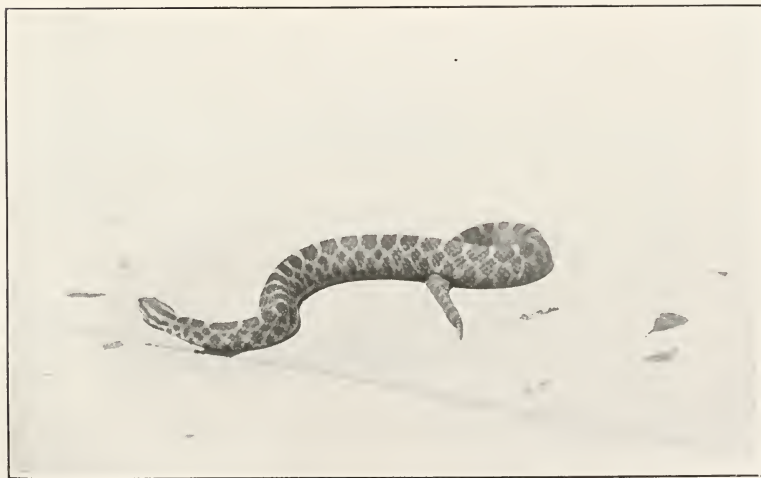
B. *HETERODON PLATYRHINUS*.



BASCANION CONSTRICTOR, ON A LIMB TEN FEET FROM THE GROUND.



A. *PLATYPELTIS SPINIFERA*.



B. *SISTRURUS CATENATUS*.



THAMNOPHIS SIRTALIS.



THAMNOPHIS SIRTALIS.



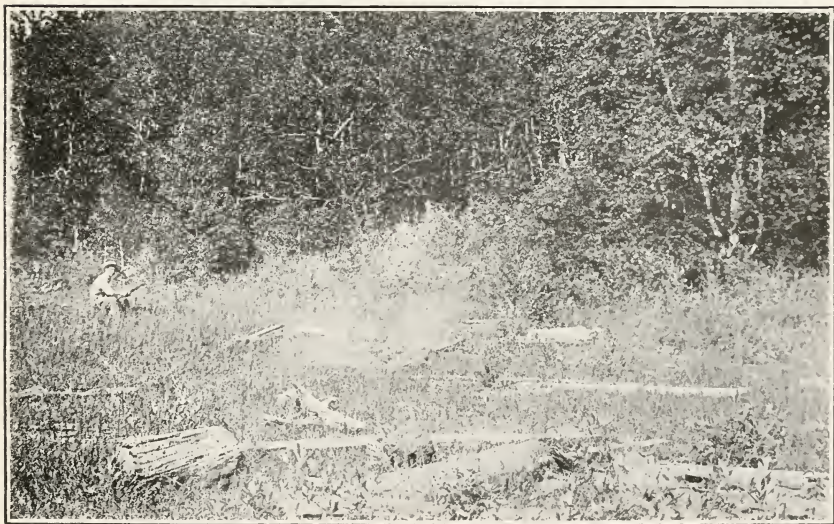
A. WHITE'S WOODS NEAR ANN ARBOR. HABITAT OF THE FROGS, TREE-FROGS, TOAD, SALAMANDERS, GARTER SNAKES, DE KAY SNAKE, AND MILK SNAKE, CHARACTERISTIC OF THE REGION.



B. MARGIN OF POND IN WHITE'S WOODS NEAR ANN ARBOR, HABITAT OF *DIEMICTYLUS VIRIDESCENS* (land form)



A. POND SOUTH OF CASSOPOLIS. HABITAT OF *RANA PIPIENS*.



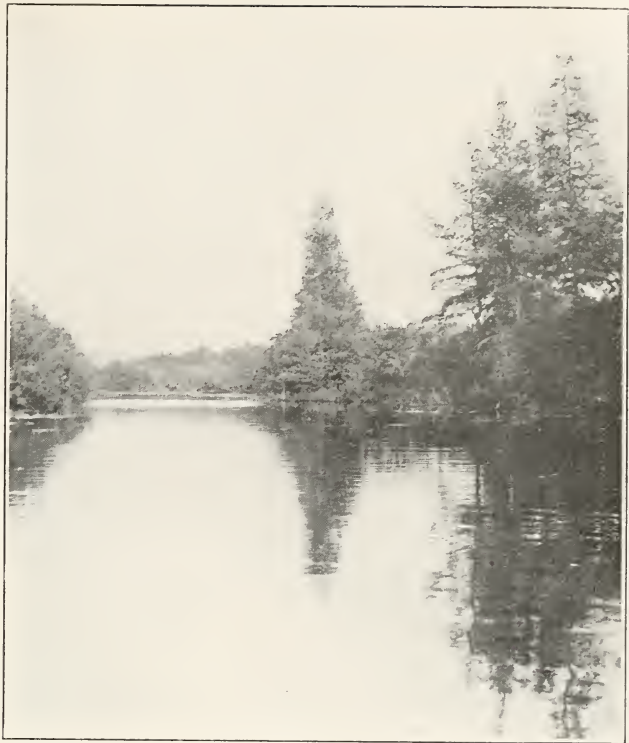
B. SHORE OF CHARITY ISLAND, SAGINAW BAY. HABITAT OF *AMBYSTOMA JEFFERSONIANUM*.



A. CHRISTIANN CREEK, CASS COUNTY. HABITAT OF *RAIA CATESBEANA*.



B. PINE BARRENS AT PORT AUSTIN. HABITAT OF *HYLA VERSICOLOR*
AND *HETERODON FLATYRHINUS*.



A. CARP RIVER, ONTONAGON COUNTY. HABITAT OF *RANA SEPTENTRIONALIS* AND *CHRYSEMYS BELLII*.



B. POND IN WHITE'S WOODS NEAR ANN ARBOR. HABITAT OF *AMBYSTOMA TIGRINUM*, *A. PUNCTATUM* AND *ACRIS GRILLUS*.

Upper labials. The series of scales along the margin of the upper jaw in snakes. (See Fig. 21.)

Ventral plates. The large scales on the ventral surface of the body in snakes. (See Fig. 23.)

Vertebral plates. The median dorsal series of scutes on the carapace in turtles. (See Fig. 24.)

GENERAL BIBLIOGRAPHY.

1857. Agassiz, Louis. Contributions to the Natural History of the United States, I.
1901. Atkinson, E. A. The Reptiles of Allegheny County, Pennsylvania. Annals Carnegie Museum, I, pp. 145-157.
1853. Baird, S. F. and Girard, C. Catalogue of North American Reptiles. Smithsonian Miscellaneous Collections, 49.
1891. Blatchley, W. S. Jour. Cincinnati Soc. Nat. Hist., 1891.
1903. Brimley, C. F. Notes on the Reproduction of Certain Reptiles. American Naturalist, XXXVII, pp. 261-266.
1902. Clark, H. L. Notes on the Reptiles and Batrachians of Eaton County. Fourth Annual Report Michigan Academy of Science, pp. 192-194.
1903. Clark, H. L. Notes on the Michigan Snakes. Fifth Annual Report Michigan Academy of Science, pp. 172-174.
- 1903a. Clark, H. L. The Short-mouthed Snake (*Eutainia brachystoma* Cope) in Southern Michigan. Proceedings Biological Society Washington, 1903, pp. 83-87.
- 1903b. Clark, H. L. The Water Snakes of Southern Michigan. Amer. Nat., XXXVII, pp. 1-23.
1905. Clark, H. L. A Preliminary List of the Amphibia and Reptilia of Michigan. Seventh Annual Report Michigan Academy of Science, pp. 109-110.
1911. Cochran, Ethel M. The Biology of the Red-backed Salamander. Biol. Bull., XX, pp. 332-350.
1900. Cope, E. D. Crocodilians, Lizards and Snakes of North America. Report U. S. National Museum, 1898 (1900), pp. 153-1270.
1889. Cope, E. D. Batrachia of North America. Bull. U. S. National Museum, 34.
1878. Coues, E and Yarrow, H. C. Notes on the Herpetology of Dakota and Montana. Bull. U. S. Geog. and Geol. Surv. Terr., IV, pp. 259-291.
1878. Cragin, F. W. Amer. Nat., XII, 820-821.
1842. DeKay, J. E. Reptiles and Amphibia. New York Fauna.
1906. Dickerson, Mary C. The Frog Book. New York.
1907. Ditmars, R. L. The Reptile Book. New York.

1906. Eycleshymer, Albert C. The Habits of *Necturus maculosus*. Amer. Nat., XI, pp. 123-137.
1901. Gadow, Hans. Amphibia and Reptiles. The Cambridge Natural History.
1891. Gage, Simon Henry. Life-History of the Vermillion-Spotted Newt. Amer. Nat., XXV, pp. 1084-1110.
1892. Garman, H. A Synopsis of the Reptiles and Amphibians of Illinois. Bull. Ill. State Lab. Nat. Hist., 1891, pp. 215-388.
1892. Gibbs, M. Forest and Stream, XXXIX, p. 7.
1900. Gibbs, M. Herpetology of Kalamazoo County, Michigan. Wolverine Nat., February, 1900, pp. 12-13.
1905. Gibbs, Notestein and Clark. See Clark, H. L., 1905.
1908. Hahn, Walter H. Notes on the Mammals and Cold-Blooded Vertebrates of the Indiana University Farm, Mitchell, Indiana. Proc. U. S. Nat. Mus., XXXV, pp. 545-581.
1856. Hallowell, E. H. Proc. Acad. Nat. Sci. Phila., 1856, p. 310.
1908. Hankinson, T. L. Biological Survey of Walnut Lake, Michigan. Ann Rept. Geol. Surv. Mich. for 1907, pp. 153-288.
1887. Hay, O. P. The Massasauga and Its Habits. Amer. Nat., XXI, pp. 211-218.
1892. Hay, O. P. On the Breeding Habits, Eggs, and Young of Certain Snakes. Proc. U. S. Nat. Mus., XV, pp. 385-397.
- 1892a. Hay, O. P. The Batrachians and the Reptiles of Indiana. Rept. Ind. Dept. of Geology and Nat. Resources, XVII, (1891) pp. 409-610.
1898. Hodge, C. F. The Common Toad. Nature Study Leaflet, Biology Series, No. 1.
1842. Holbrook, E. North American Herpetology. Philadelphia.
1911. Hurter, Julius. Herpetology of Missouri. Transactions of the Acad. of Science of St. Louis, XX.
1899. Jordan, David Starr. A Manual of the Vertebrate Animals of the Northern United States.
1893. Jordan, Edwin O. The Habits and Development of the Newt (*Diemictylus viridescens*). Jour. of Morphology, VIII, pp. 269-366.
1895. Kirsch, Phillip H. A Report upon Investigations in the Maumee River Basin during the Summer of 1893. Bull. U. S. Fish Comm., XIV, p. 333.
1878. Merriam, C. H. Science News.
1861. Miles, Manly. A Catalogue of the Mammals, Birds, Reptiles and Mollusks of Michigan. 1st Bien. Rept. Geol. Surv. Mich., pp. 219-241.

1874. Milner, J. W. Report on the Fisheries of the Great Lakes: the Result of Inquiries Prosecuted in 1871 and 1872. Rept. U. S. Fish Comm., 1872-73, pp. 1-75.
1904. Morse, Max. Batrachians and Reptiles of Ohio. Proc. Ohio State Acad. of Science, IV, pp. 91-144.
1906. Newman, H. The Habits of certain Tortoises. Jour. Comp. Neur. and Psyc., XVI, pp. 126-152.
1905. Notestein, F. N. The Ophidia of Michigan. Seventh Ann. Rept. Mich. Acad. Science, pp. 112-125.
1906. Ortmann, A. E. The Crawfishes of the State of Pennsylvania. Mem. Carnegie Mus., II, pp. 343-533.
1910. Piersol, W. H. Spawn and Larvae of *Ambystoma jeffersonianum*. Amer. Nat., XLIV, pp. 732-738.
1868. Putnam, F. W. Do Snakes Swallow Their Young. Amer. Nat., II, p. 136.
1895. Reddick, G. Snakes of Turkey Lake. Proc. Ind. Acad. Sci., 1895, pp. 261-262.
1904. Ruthven, Alexander G. Butler's Garter Snake. Biol. Bull., VII, pp. 289-299.
- 1904a. Ruthven, Alexander G. Notes on the Molluscs, Reptiles and Amphibians of Ontonagon County, Michigan. Sixth Ann. Rept. Mich. Acad. Sci., pp. 188-192.
1906. Ruthven, Alexander G. The Cold-Blooded Vertebrates of the Porcupine Mountains and Isle Royale, Michigan. Rept. Geol. Surv. Mich., 1905 (1906), pp. 107-112.
1908. Ruthven, Alexander G. Variations and Genetic Relationships of the Garter Snakes. Bull. U. S. Nat. Mus., 61.
1909. Ruthven, Alexander G. The Cold-Blooded Vertebrates of Isle Royale. Rept. Geol. Surv. Mich., 1908 (1909), pp. 116-117.
- 1909a. Ruthven, Alexander G. Notes on Michigan Reptiles and Amphibians. Eleventh Ann. Rept. Mich. Acad. of Sci., pp. 116-117.
1910. Ruthven, Alexander G. Notes on Michigan Reptiles and Amphibians, II. Twelfth Ann. Rept. Mich. Acad. of Sci., p. 59.
1911. Ruthven, Alexander G. Notes on Michigan Reptiles and Amphibians, III. Thirteenth Ann. Rept. Mich. Acad. of Sci., pp. 114-115.
- 1911a. Ruthven, Alexander G. Amphibians and Reptiles in A Biological Survey of the Sand Dune Region on the South Shore of Saginaw Bay, Michigan. Geol. and Biol. Surv. Mich., Pub. 4, Biol. Ser. 2, pp. 257-272.



A. WOODS OF CHARITY ISLAND. HABITAT OF *LAMPROPELTIS DOL-
ATUS TRIANGULUS*.



B. DECAYING LOG IN WOODS AT PORT AUSTIN. BREEDING PLACE OF
PLETHODON ERYTHRONOTUS.

1839. Sager, Abraham. Catalogue of Mammals, Birds, Reptiles, Amphibians, Fishes, and Molluscs of Michigan. Senate Doc. State of Mich., 1839, pp. 294-305.
1909. Siebenrock, F. Synopsis der rezenten Schildkroten, mit Berücksichtigung der historischer Zeit ausgestorbenen Arten. Zool. Jahrb., Supp. 10, Heft 3.
1907. Smith, Bertram G. The Breeding Habits of *Ambystoma punctatum* Linn. Amer. Nat., XLI, pp. 381-390.
1910. Smith, Bertram G. The Structure of the Spermataphores of *Ambystoma punctatum*. Biol. Bull., XVIII, pp. 204-211.
1911. Smith, Bertram G. The Nest and Larvae of *Necturus*. Biol. Bull., XX, pp. 191-201.
- 1911a. Smith, Bertram G. Notes on the Natural History of *Ambystoma jeffersonianum*, *A. punctatum* and *A. tigrinum*. Bull. of the Wisconsin Nat. Hist. Soc., IX, pp. 14-28.
1877. Smith, W. H. The Tailed Amphibians, including the Caeilians. A Thesis presented to the Faculty of Michigan University.
1879. Smith, W. H. Catalogue of the Reptilia and Amphibia of Michigan. Supp. to Science News, 1879.
1882. Smith, W. H. Report on the Amphibians and Reptiles of Ohio. Rept. of the Geol. Surv. of Ohio, IV, pp. 633-735.
1903. Sperry, W. L. Variation in the Common Garter Snake (*Thamnophis sirtalis*). Fifth Ann. Rept. Mich. Acad. of Sci., pp. 175-179.
1893. Stejneger, L. The Poisonous Snakes of North America. Rept. U. S. Nat. Mus., 1893, pp. 339-487.
1892. Stejneger, L. apud Hay, 1892, p. 396.
1908. Strecker, John K. Notes on the Breeding Habits of *Phrynosoma cornutum* and other Texas Lizards. Proc. Biol. Soc. Wash., XXI, pp. 165-170.
1906. Surface, H. A. The Serpents of Pennsylvania. Zool. Bull. Penn. Dept. of Agri., IV, pp. 113-202.
1908. Surface, H. A. First Report on the Economic Features of the Turtles of Pennsylvania. Zool. Bull. Penn. Dept. of Agri., VI, pp. 105-195.
- 1908a. Surface, H. A. The Lizards of Pennsylvania. Zool. Bull. Penn. Dept. of Agri., V, pp. 234-258.
1892. Taylor, W. E. The Ophidia of Nebraska. Ann. Rept. Neb. St. Board Agri., 1891, pp. 310-357.
1911. Thompson, Crystal. Notes on the Amphibians and Reptiles of Cass County, Michigan. Thirteenth Ann. Rept. Mich. Acad. Sci., pp. 105-107.

1893. True, F. W. Useful Aquatic Reptiles and Batrachians of the United States. Fisheries & Fishery Industries of the U. S., Sec. I, pp. 141-162.
1905. Whittaker, C. C. The Status of *Eutaenia brachystoma*. Seventh Ann. Rept. Mich. Acad. Sci., pp. 88-92.
- 1905a. Whittaker, C. C. Variation in the Blue Racer. Seventh Ann Rept. Mich. Acad. Sci., pp. 100-102.
1908. Wright, Albert H. Notes on the Breeding Habits of *Ambystoma punctatum*. Biol. Bull., XIV, pp. 284-290.
1909. Wright and Allen. The Early Breeding Habits of *Ambystoma punctatum*. Amer. Nat., XLIII, pp. 687-693.
1869. Verrill, A. E. Amer. Nat., III, pp. 158-159.



A. POND NEAR GEDDES, WASHTENAW COUNTY. HABITAT OF *R. PALUSTRIS* AND *R. CLAMITANS*.



B. UNDERGROWTH IN WOODS NEAR PORT AUSTIN. HABITAT OF *PLETHODON ERYTHRONOTUS*.

MEMORANDA TOWARDS A BIBLIOGRAPHY OF THE ARCHAEOLOGY OF MICHIGAN.

HARLAN I. SMITH.

Victoria Memorial Museum, Ottawa, Canada.

- ABBOTT, (CHAS. C.). *Primitive Industry*, pp. 270-325.
- American Antiquarian, Vol. 1, 1878, p. 8, mentions an embankment in Branch County.
- American Antiquarian, Vol. XI, No. 4, 1889, p. 249, refers to Saginaw Grave.
- American Association for the Advancement of Science, Proceedings, Vol. XXIV, 1875, pp. 311, 316-322, mentions mound in Wayne County.
- American Association for the Advancement of Science, Proceedings, Vol. XXV, 1876, p. 324, mentions mound in Wayne County.
- American Association for the Advancement of Science, Proceedings, Vol. XXVI, 1877, pp. 336-337, mentions mound in Wayne County.
- ANDERSON, (ABEL). Smithsonian Report for 1879, p. 434, reports mounds in Newaygo County; p. 434, reports mounds in Ottawa County.
- ARMSTRONG, (BENJ. G.). *Early Life among the Indians*. Press of A. W. Bowron, Ashland, Wisconsin, 1892, p. 150.
- BALDWIN. *Ancient America*, p. 43-45, mentions copper mines in Ontonagon County.
- BARNES, (CHAS. E.). Smithsonian Report, 1879, p. 434.
- BEAUCHAMP, (WM. M.). *A History of the New York Iroquois*, Bulletin 78 (Archaeology 9) of the New York State Museum, p. 396, refers to Sanson's map of 1656; p. 398, refers to Crenoxins' map of 1660, and, p. 400, refers to Caronellis' map of 1688.
-
- Indian Nations of the Great Lakes*, American Antiquarian, Nov. 1895, Vol. XVII, No. 6.

Berrien County. See United States National Museum Report, 1886, p. 107.

BLOIS, (JOHN T.). Gazetteer of the State of Michigan, 1838-1840 (copyrighted 1838), p. 165, mentions mounds in Lenawee County; p. 168, mentions sites in Calhoun County; pp. 168-170, mentions sites in Macomb County; pp. 173-177, mentions garden beds.

BOYLE, (DAVID). Archaeological Report, Ontario, 1901, pp. 32-35, mentions matter for comparison with Ogemaw County enclosures.

————— Archaeological Report, Ontario, 1903, Toronto, 1904, p. 91, mentions perforated skulls from Canada similar to those of Michigan.

BRADY, (SAMUEL). Smithsonian Report for 1879, p. 434, reports that he is exploring copper mines on Isle Royale.

Branch County. See United States National Museum Report 1889, p. 118.

BROWER, (J. V.). *Kathio, Memoir of Explorations in the Basin of the Mississippi*, St. Paul, Minn., 1901, page opposite Plate II mentions copper.

CANFIELD, (—). *Sketches of Sauk County, Wisconsin*, American Antiquarian, 1890, refers to garden beds.

CARSON, (H. H.). American Antiquarian, Vol. IX, No. 4, July 1887, p. 237, mentions village sites in Clinton County; p. 238, mentions mounds, effigy mounds and garden beds in Saginaw County, and, pp. 237 and 238, mentions sites in Shiawassee County.

CATHERWOOD, (MARY HARTWELL). *The White Islander* (Indians), Century Magazine, Sept. 1893.

CHARLEVOIX, (SAGARD). *Voyage au grand pays des Hurons*.

COFFINBERRY, (W. L.) and STRONG, (E. A.). Proceedings of the American Association for the Advancement of Science, Vol. XXIV, 1875, pp. 293-297, describes mounds in Kent County.

CONANT, (A. J.). *Foot Prints of Vanished Races in the Mississippi Valley*, p. 65, refers to garden beds. Barnes, says p. 181, of Nadaillac.

Copper Mine in Michigan, Records of the Past, Vol. II, Part 7, July 1903, p. 223.

Copper. See Brower, Detroit, Moore, Palmer, Short, Whittlesey, Wisconsin Archaeologist, Vol. II, No. 1, Oct. 1902, p. 23.



MOSS COVERED STUMPS IN CADY'S WOODS SOUTH OF ANN ARBOR.
HABITAT OF *HEMIDACTYLUM SCUTATUM*.

- COPWAY, (G.). *The Traditional History and Characteristic Sketches of the Ojibway Nation*, London, 1850.
- Courier, see Saginaw.
- DAN, (JOHN E.). Smithsonian Report 1879, p. 434, reports that he has in preparation a manuscript on forts and mounds of Macomb County.
- DAVIS, (A. C.) *Antiquities of Isle Royale*, Smithsonian Report 1874.
- DODGE, (BYRON E.). American Archaeologist, Nov. 1898, Vol. II, Part 11, p. 299, refers to shell-heap on Flint River near Richfield, Genesee County.
- American Archaeologist, March 1898, Vol. I, Part 3, p. 78, refers to supposed bridge across Flint River, Sec. 15, Genesee Tp., Genesee County.
- Detroit Evening News.
- Detroit Free Press, August 2, 1903, mentions copper.
- Detroit Free Press, July 8, 1900, mentions Bert Marsh's Collection.
- Detroit Free Press, May 1, 1901, refers to grave in Wayne County.
- ELSWORTH, Epworth Assembly Quarterly, IV, 1897, p. 7, refers to a site in Mason County.
- EVERTS, (L. H.). *History of Calhoun County*, 1877, p. 11, mentions sites in Calhoun County.
- *History of St. Joseph County, Michigan*, 1877, p. 11, mentions sites in St. Joseph County.
- EVERTS and ABBOTT. *History of Kalamazoo County*, Philadelphia, 1880, mentions sites in Kalamazoo County; p. 65, mentions garden beds; p. 68, cuts of garden beds on W. B. Cobbs' Farm at Schoolcraft, also one at Galesburgh and one in Kalamazoo, probably the one in the Park west of the mound.
- FARMER, (SILAS). *History of Detroit and Michigan*, 1884, p. 321, mentions mounds in Wayne County.
- FISHER, (A. W.). *Cache of Leaf-shaped Relics*, Popular Science News, February, 1901, Vol. XXXV, No. 2, p. 38.
- FOSTER, (J. W.). *Prehistoric Races of the United States of America*, p. 265, p. 266, mentions copper mines in Ontonagon County; p. 155, mentions garden beds.
- FOSTER and WHITNEY's Report, 1850, p. 162, mentions mines in Keweenaw County; pp. 161-162, notices copper mines in Keweenaw County; pp. 159-161, describes and figures copper mines in Ontonagon County, and, p. 161, mentions mounds in Ontonagon County.

FOWLER, (S. W.). Smithsonian Report, 1879, p. 434, mentions shell-heaps and sites in Manistee County.

FOWKE, (GERARD). Copy of Fowke's Report on Michigan. A carefully compared copy made with permission of Professor Thomas from a copy made by Rev. Wm. M. Beauchamp, of Syracuse, N. Y., for his use while assisting in preparing the Thomas Catalogue.

————— Mr. Gerard Fowke of Chillicothe, Ohio, made a reconnaissance of Michigan for the Bureau of American Ethnology.

GALATIAN, (A. B.). See I. M. Thomas.

GIBBS, (MORRIS). *Origin of Mounds*, Popular Science, March, 1899, p. 59.

GILLMAN, (HENRY). Smithsonian Report, 1874, pp. 369, 370, describes mines in Keweenaw County.

————— Appleton's Journal, Vol. X, 1873, p. 173, describes mines in Keweenaw County.

————— 6th Report of the Peabody Museum, pp. 13-19, describes and figures mounds in St. Clair County.

————— Smithsonian Report, 1873, pp. 380-382, describes and figures mounds in Emmett County; pp. 378, 379, describes mounds in Iosco County; pp. 387-390, describes and figures pits in Keweenaw County; p. 380, mentions with plat mound in Mackinac County; pp. 382-384, describes with plat and figures mounds in Manitou County; p. 380, mentions mound in Presque Isle County; pp. 370-374, describes and figures mound in St. Clair County; pp. 367-368, describes and figures mound in Wayne County; pp. 364-365, partly describes with map mound in Wayne County.

————— *The Mound-Builders and Platyneism in Michigan*, Smithsonian Report 1873, Government Printing Office, 1874, pp. 364-390, Figs. 1-12, some being maps.

————— Also reprint 1877.

————— *Certain Characteristics Pertaining to Ancient Man in Michigan*, Smithsonian Report 1875, Government Printing Office, 1876, pp. 234-245, Figs. 1-13.

————— Also reprint 1877.

————— *The Ancient Men of the Great Lakes*. Abstract from Proceedings of the American Association for the Advancement of Science, Vol. XXIV, Salem, 1876, pp. 316-331, Figs. 1-7. Read August 16, 1875, at Detroit meeting.



————— *Perforation of the Humerous conjoined with Platy-
cnemism*, American Naturalist, Vol. IX, No. 7, 1875,
pp. 427-428.

Grand Rapids. The Evening Press, February 20, 1904, refers to
sites in Kent County.

Handbook of the American Indians, Bulletin 30 of the Bureau of
Ethnology, pp. 149-150, refers to Saginaw County; p.
139, refers to Manitou County; p. 58, refers to Sagi-
naw County; p. 535, mentions piece of hafted celt
from Michigan; p. 345, refers to copper from Michi-
gan.

HAUPTMAN. (See Science.)

HAVARD, (DR. V.). *The French Half Breeds of the Northwest*,
Smithsonian Report, 1879, pp. 309-327; p. 318, men-
tions Michigan.

HAVEN, (—). *Archaeology of the United States*, contains report
of Verandrier who explored this region before 1748.

HILLS, (LESLIE W.). American Archaeologist, March 1898, p. 77,
refers to a cache in Berrien County.

HINSDALE, (W. B.). Washtenaw Times, Ann Arbor, June 23, 1901,
mounds in Washtenaw County.

History of Kalamazoo County.

HOLMES, (WM. H.). *Aboriginal Copper Mines of Isle Royale*, Lake
Superior, American Anthropologist, N. S., Vol. 3,
1901, pp. 684-696, Plates XXIII-XXIV, Fig. 73.

History of Saginaw County, Michigan; together with sketches of its
cities, villages and townships, educational, religious,
civic, military, and political history; portraits of
prominent persons, and biographies of representative
citizens. History of Michigan, embracing accounts of
the pre-historic races, aborigines, French, English and
American conquests, and a general review of its civil,
political and military history. Illustrated. Chicago,
Chas. C. Chapman & Co., 1881, pp. 960. P. 268, refers
to Rifle River in Ogemaw County; p. 287, refers to
sites in Iosco County.

HODGMAN, (F.). *The Old Fort*, written for the Michigan Pioneer
and Historical Society, June 5, 1902. Refers to fort
in Kalamazoo County.

HOUGHTON, (JACOB). *Ancient Copper Mines of Lake Superior*,
mentions mines in Ontonagon County.

HUBBARD, (BELA). American Antiquarian, Vol. I, 1878, pp. 4-9,
partly describes and figures garden beds in Kalamazoo

County; p. 7, partly describes rectangular and circular embankments in Kalamazoo County; p. 4 and Fig. 4, mentions garden beds in St. Joseph County.

Memorials of a Half Century, 1887, Copyrighted G. P. Putnam Sons, p. 185, mentions L'Arbe Croche Village Site in Emmett Co.; p. 203, describes, with cut, sites in Macomb County.

Ancient Garden Beds of Michigan, Pioneer Collections of the State of Michigan, Vol. II, 1877-78, pp. 21-27 and maps pp. 28-35, partly describes and figures garden beds in Kalamazoo County.

HUBBARD, (LUCIUS). Smithsonian Report, 1879, pp. 434-435, mentions mounds in Berrien County.

Huron, see Miner.

JENISON, (O. A.). Smithsonian Report, 1879, p. 435.

JENKS, (ALBERT ERNEST). *The Wild Rice Gatherers of the Upper Lakes*, 19th Report of the Bureau of Ethnology, Part 2, p. 1050, refers to Saginaw County and Bay County.

JENNINGS, (H. S.). The Michigan Academy of Science, Science N. S. XIII, No. 329, April 19, 1901, p. 616, refers to papers by Harlan I. Smith on "An Archaeological Survey of Michigan: The Antiquities of Michigan, Their Value and Impending Loss."

JONES, (JOSHUA). Smithsonian Report, 1879, p. 435, mentions mounds in Livingston County.

JONES, (PETER). *History of the Ojibway Indians*, 1861.

KELTON, (DWIGHT H.). *Annals of Fort Mackinac*, Copyrighted 1892.

KINZIE, (MRS. JOHN H.). "Wau-Bun the Early Day in the Northwest." New York, 1856.

KOHL, (J. G.). "Kitchi-Gami Wanderings Round Lake Superior." London, 1860.

LA HONTON. *New Voyages*, Vol. I, p. 93, 1703, refers under the names Otontagans and Ottawas of Talon, to Otontagan, an Ottawa band living before 1680 on Manitoulin Island and driven out by the Iroquois.

LAPHAM, (I. A.). *Antiquities of Wisconsin*, p. 74, mentions copper mines in Ontonagon County and garden beds.

LARMOUR, (J. J.). Smithsonian Report 1880, p. 444, mentions mounds in Calhoun County.

LATHROP, (J. H.). *Prehistoric Mines of Lake Superior*, American Antiquarian, Vol. XXIII, No. 4, July and August 1901.

Also printed in Northwest Magazine, Feb. 1901.

LEACH, (M. L.). *Ancient Forts in Ogemaw County, Michigan*, Annual Report of the Smithsonian Institution, 1884, Washington, Government Printing Office, 1885, pp. 849-851, with two maps.

Also reprint in Papers Relating to Anthropology from the Smithsonian Report for 1884, Washington, Government Printing Office, 1885, pp. 11-13, with two maps.

Ancient Mounds in Clinton County, Michigan, Annual Report of the Smithsonian Institution, 1884, Washington, Government Printing Office, 1885, pp. 839-848, describes and figures mounds; pp. 840-841, describes and figures mounds on a flat in Shiawassee County.

Also reprint in No. 620 Papers Relating to Anthropology from the Smithsonian Report for 1884, Washington, Government Printing Office 1885.

Address Traverse City, Michigan.

LEESON, (M. A.). *History of Macomb County, Michigan*, 1882, mentions sites in Macomb County.

MANKTELOW, (CHAS. W.). The American Archaeologist, April 1898, p. 105, and the American Archaeologist, December 1898, p. 323, reports mounds or earthworks near Boone and Cadillac, Wexford County.

Prehistoric Remains in Northern Michigan, Popular Science News, Nov. 1902, p. 289.

Address Cadillac, Michigan.

MASON, (OTIS T.). *Papers Relating to Anthropology*, 1884, pp. 4-10, mentions mounds in Clinton County; pp. 11-13, mentions enclosures in Ogemaw County; pp. 1-4, mentions mounds in Shiawassee County.

United States National Museum Report 1902, p. 385, refers to Angwassag, Saginaw County.

MCCORMICK, (W. K.). *Mounds and Mound Builders of the Saginaw Valley*, Michigan Pioneer Collection, Vol. IV, 1881, Lansing, W. S. George & Co., 1883, p. 382, mentions sites in Bay County and refers to Ogemaw County; p. 379, mentions enclosures in Ogemaw County, and describes mounds in Genesee County; p. 380, mentions mounds and earthworks in Saginaw County.

- MACLEAN, (JNO. P.). *Mound Builders*, pp. 76-77, mentions copper mines in Ontonagon County.
- MALLORY, (ISAAC). *History of Baptist Indian Missions*, 1840, p. 366, mentions mound in Wayne County.
- MIDDLETON, (JAMES D.). *The Smithsonian Report*, 1889, footnoté on p. 47 in appendix I, refers to his work in Michigan.
- Miner, The Michigan, Nov. 1, 1901. *The Lake Huron Region*. An early geographical Sketch of Lake Huron with accompanying map of interest. Saginaw, Michigan.
- Vol. VI, No. 2, January 1902, p. 12, mentions copper.
- MOORE, (CHARLES). *The Ontonagon Copper Boulder in the United States National Museum*, United States National Museum Report for 1895, pp. 1021-1030, with two plates, Washington, Government Printing Office, 1897.
- Also reprint.
- MOOREHEAD, (WARREN K.). *Prehistoric Implements*, Cincinnati, 1900, pp. 23 and 307, mentions a cache.
- MORSE, (JEDIDIAH). Report to the Secretary of War of the United States on Indian Affairs, 1822, Appendix, p. 19, refers to Saganau.
- Muir, Michigan. (Ionia County). *Story of a Fort Near Muir, Michigan*, Detroit News, Feb. 25, 1893.
- Also reprint in the Archaeologist, Vol. I, No. 4, pp. 65-67.
- NADAILLAC. *Prehistoric America*, p. 81, refers to garden beds.
- New York Times, January 9, 1908, mentions discovery of a copper axe at Presque Isle, Presque Isle County.
- March 23, 1902, mentions copper found at Lake Gogebic.
- August 10, 1902, refers to perforated skulls found near Arkona, Ontario, similar to those found in Michigan.
- OAKES, (H. E.). *The Garden Beds of Michigan Modeled*. American Antiquarian, Vol. XVIII, No. 6, November 1896, p. 323.
- PACKARD, (R. L.). *Pre-Columbian Copper Mining in North America*, Smithsonian Report for 1892, Washington, Government Printing Office, 1893, pp. 175 and 178, refers to Marquette.
- Also reprint, p. 919.
- *Pre-Columbian Copper Mining in North America*, American Antiquarian, March, 1893, Vol. XV, No. 2,

pp. 67-78, continued in *American Antiquarian*, May, 1893, Vol. XV, No. 3, pp. 152-164.

PALMER, (FRIEND). *Early Days in Detroit*, p. 247, mentions copper. Peabody Museum, Harvard University, 10th Annual Report, 1877 (Reports II) p. 20, refers to photograph, 11054, of stone ornament found in Fruitport, Michigan, presented by W. L. Coffinberry of Grand Rapids, Michigan.

————— 16th and 17th Annual Reports, 1884, (Report III), p. 202, articles 29476-29521 from mound on Devil River, collected by Henry Gillman and presented by Stephen Salisbury.

————— 19th Annual Report, 1886, p. 505, 38225, perforated crania, mound on River Rouge presented by Bela Hubbard. P. 508, articles from mound at Grand Rapids presented by W. L. Coffinberry.

PECK, (WILLIAM IRA). *The Evening News*, Detroit, Dec. 7, 1901, refers to fort in Ogemaw County.

PEET, (STEPHEN D.). *American Antiquarian*, Vol. VII, 1885, pp. 23-28, describes and figures garden beds in Kalamazoo County.

————— *Emblematic Mounds*, Vol. II, p. 131, refers to garden beds.

Perforated, see Saginaw.

Pioneer Collections, Vol. II, 1877-78, p. 45, mentions sites in Manitou County.

Popular Science, March 1899, p. 59.

Popular Science Monthly, 1881, p. 601, mentions copper.

POST, (H. D.). *Michigan Pioneer Collections*, Vol. III, 1879-80, p. 296, mentions sites in Allegan County.

RILEY, (HENRY H.). *Michigan Pioneer Collections*, Vol. III, 1879-80, p. 14, refers to mounds discovered by Gillman in St. Clair County.

ROYCE. Map 1st. Report of the Bureau of American Ethnology, 1881, refers to Pocagons Village (Pocagon).

SAGARD, (THEODAT, GABRIEL). *Le Grand Voyage au Pays des Hurons*.

Saginaw Courier-Herald, June 30, 1901, refers to an earthwork in Ogemaw County.

————— January 29, 1903, mentions mound in Genesee County.

————— March 14, 1903, refers to perforated skull from Bay County in *American Museum of Natural History*.

- Nov. 1, 1905, Nov. 11, 1905, Dec. 17, 1905, and Dec. 30, 1905, refers to graves at Bridgeport, Saginaw County.
- May, 1907, mentions graves at Bridgeport, Saginaw County.
- Saginaw Evening News, June 1, 1888, refers to Saginaw Grave.
- December 31, 1902, mentions Edinger collection.
- September 23, 1909, mentions a grave in Berrien County.
- SAUR, (WM. C). *Illustrated Atlas of Kalamazoo County, Michigan*, with Early and Present History, Detroit, Mich., 1890, p. 79, refers to garden beds.
- SCHOOLCRAFT, (HENRY R.). *Historical and Statistical Information respecting the History, Conditions and Prospects of the Indian Tribes of the United States*, Lippincott, Grambo & Company, 1851-1857, Vol. I, pp. 50-54-60 with plates VI and VII, refer to garden beds in the Grand River Valley.
- Science, February 21, 1902, p. 309, refers to Hauptman Earthwork in Ogemaw County.
- SHORT, (—). North Americans of Antiquity, pp. 89-92, mentions copper mines in Ontonagon County.
- SMITH, (HARLAN I.). *The Antiquities of Michigan Their Value and Impending Loss*. John F. Elby & Co., Detroit, Michigan. A reprint of a syndicated article which appeared in the Detroit Evening News and the Detroit Free Press.
- Prehistoric Michigan*, Popular Science News, May, 1901, pp. 110-111.
- Also reprint.
- An Archaeological Survey of Michigan*, Third Report of the Michigan Academy of Science, 1901, pp. 35-37.
- Also separate.
- Archaeological Survey of Michigan*. Presented before the Michigan Academy of Science at its seventh annual meeting, Ann Arbor, March 28, 1901, pp. 198-200.
- American Anthropologist, N. S., Vol. III, January-March, 1901. This paper with slight changes the same as "An Archaeological Survey of Michigan."
- Also reprint.

In Primitive Times. Saginaw Evening News, April 9th, 1894.

The Saginaw Valley Collection. The culture of the people once inhabiting a limited area near Saginaw, Michigan, as illustrated by material in the Anthropological Department of the American Museum of Natural History. Illustrated, 2 maps, 24 pp. Supplement to American Museum Journal, Vol. I, No. 12, November-December, 1901. A popular account.

Anthropological Matters in Michigan, read at the 43rd Meeting of A. A. A. S. at Brooklyn, N. Y., 1894.

Relics of an Early Race, Detroit Free Press, October 21, 1894, refers to sites in Saginaw and Kalamazoo Counties.

Study of Man, Detroit Free Press, Nov. 12, 1893.

Legendary Invasion of the Saginaw Valley, American Antiquarian, Chicago, Vol. XIII, No. 6, Nov. 1891, pp. 339-340.

Reprinted under the title—*The Invasion of Saginaw Valley*. A legend of northern Michigan as told by an Indian, Detroit Free Press, Sunday, January 3, 1892, p. 11, column 4, also in daily issue of Saginaw Courier-Herald, January 7th, and in the weekly issue of the same January 14, 1892.

The Archaeology of the Saginaw Valley as illustrated at the World's Columbian Exposition.

Also reprint.

Notes on the Data of Michigan Archaeology. Presented at the first meeting of the Michigan Academy of Science, Dec. 26, 1894. American Antiquarian, Vol. XVIII, No. 3, May, 1896, p. 144, part I.

Also reprint.

The Development of Michigan Archaeology. Presented at the first meeting of the Michigan Academy of Science, Dec. 26, 1894. The Inlander, VI, 8, May, 1896, part II.

Also reprint.

Partial Reprint in Preservation of Local Archaeological Evidences, Report of the Museums Association of the United Kingdom. Brighton Meeting for 1899.

Also reprint, 1900.

Also reprint Sci. Am.

————— *Work in Anthropology at the University of Michigan for 1892*, University Record, Feb. 1894, pp. 98-100.

————— Reprint Courier Presses, Ann Arbor, 1894.

————— Also reprint Detroit Free Press.

————— *An Earthwork Discovered in Michigan*, Science, 1901, p. 991, refers to Hauptman Earthwork in Ogemaw County.

————— Science, 1901, p. 228, refers to Hauptman Earthwork in Ogemaw County.

————— *Primitive Remains in the Saginaw Valley, Michigan, The Ayres Mound*, The Archaeologist, Vol. 1, No. 3, March, 1893, pp. 51-53.

————— *Caches of the Saginaw Valley, Michigan*, Proceedings Am. Ass. for the Advancement of Science, Vol. XLII, 1894, pp. 300-303.

————— Also separate.

————— See also same article revised and extended in The Antiquarian, Columbus, Ohio, Vol. I, Pt. 2, Feb., 1897, pp. 30-33.

————— *Summary of the Archaeology of the Saginaw Valley, Michigan, I*, American Anthropologist, N. S. Vol. 3, No. 2, April-June, 1901, pp. 286-293.

————— Also separate.

————— *Summary of the Archaeology of the Saginaw Valley, Michigan, II*, American Anthropologist, N. S. Vol. 3, No. 3, July-September, 1901, pp. 501-512.

————— Also separate.

————— *Summary of the Archaeology of the Saginaw Valley, Michigan, III*, American Anthropologist, N. S. Vol. 3, No. 4, October-December, 1901, pp. 726-736. This article covers in the Saginaw River Valley, Saginaw County as far as Ayres Graves inclusive.

————— *Anthropological Work at the University of Michigan*, Memoir of the International Congress of Anthropology, Chicago, 1894.

————— Lyceum Advocate.

SMITH, (EMILE). Wrote in German on Michigan Copper and also translated into English.

Smithsonian Report, 1897, p. 434, refers to mounds.

————— 1892, p. 50, refers to Holmes' exploration of copper mines on Isle Royale.

SQUIER, (E. G.). *Aboriginal Monuments of New York*, p. 184, mentions copper mines in Ontonagon County.

STARR, (FREDERICK). *American Antiquarian*.

STEVENS, (EDWARD T.). *Flint Chips*, p. 540, refers to garden beds.

STOCKWELL, (G. ARCHIE). *Smithsonian Report*, 1879, p. 435, reports mounds in St. Clair County.

————— Dr. G. Archie Stockwell of Port Huron, Michigan, at the time of Mr. Fowke's reconnaissance, while hunting extensively in various parts of the state, had been watchful for mounds or other remains. He desired to make a systematic survey of Huron County and had collected many data regarding Michigan Archaeology which he freely offered to place at the disposal of science. In 1894 Dr. Stockwell removed to Detroit, Michigan.

STRONG, (E. A.). See Coffinberry.

SWINEFORD, (—). *History and Review of the Mineral Resources of Lake Superior*, mentions copper mines in Ontonagon County.

TALON. Refers to Ottawas (Otonagan).

TEED, (DELMAR E.). *American Archaeologist*, April 1898, note p. 105, assisted Chas. E. Manktelow explore mounds near Boon and Cadillac, Michigan.

————— Address Cadillac, Michigan.

THOMAS, (CYRUS). 12th Report of the Bureau of Ethnology, pp. 550 and p. 33, refers to garden beds, describes enclosures in Ogemaw County.

————— *Catalogue of Prehistoric Earth-Works East of the Rocky Mountains*, pp. 106-116, Plate X, and Archaeological map of Michigan. Washington, Government Printing Office, 1891.

THOMAS, (I. M.). and GALATIAN (A. B.). Compilers as well as publishers. *Indian Pioneer History of the Saginaw Valley with histories of East Saginaw, Saginaw City and Bay City from the earliest settlements, also Pioneer Directory and Business Advantages, 1866-67*. Published in East Saginaw. Copy Detroit Public Library.

THOMAS, (—). *Kalamazoo Directory and Business Advertisements, 1867-1868, together with History of Kalamazoo, Kalamazoo, 1867*, p. 7, refers to garden beds.

Tippecanoe Treaty (1832). U. S. Indian Treaty 701, 1873, refers to Pocagon's village (Pocagon).

University. *Wants University to Search for Prehistoric Remains.* Ann Arbor Argus Democrat, Ann Arbor, Michigan, February 27, 1903.

VERANDRIER. (See Haven.)

WARD, (HENRY L.). *A Remarkable Ceremonial Object from Michigan*, Bulletin of the Wisconsin Natural History Society, Vol. IV, N. S., No. 4, October, 1906, pp. 160-161.

Washington Treaty 1836. U. S. Indian Treaty, 1873, p. 607, refers to sites in Manitow County.

Washtenaw Times, June 26, 1901, refers to graves in Washtenaw County.

Wayerman, Walkins & Co. *History of Cass County*, 1882, mentions sites in Cass County.

Wayne County. *Find of Indian Skeletons*, American Antiquarian, November-December, 1894, Vol. XVI, No. 6, p. 383.

West Branch Herald Times, June 14, 1901, refers to wall around Rifle Lake. Possibly a natural ice push.

Western Gazetteer or Emigrant's Directory, 1817, p. 170, mentions sites in Wayne County.

WHITNEY. See Foster.

WHITTLESEY, (CHARLES). *Ancient Mines on the Shores of Lake Superior*, Contribution to Knowledge, 1863, pp. 17-20, describes and figures copper mines in Ontonagon County.

WILSON, (THOMAS). *Arrow Points, Spearheads and Knives of Prehistoric Times*. United States National Museum, 1897. P. 980, refers to caches in Saginaw County and in Huron County. Frontispiece represents a hafted celt from Genesee County.

————— Report of the United States National Museum, 1892, part 1, p. 980, refers to cache from Chippewa County.

WILSON, (DANIEL). *Prehistoric Man*. Vol. I, p. 278, refers to copper mining.

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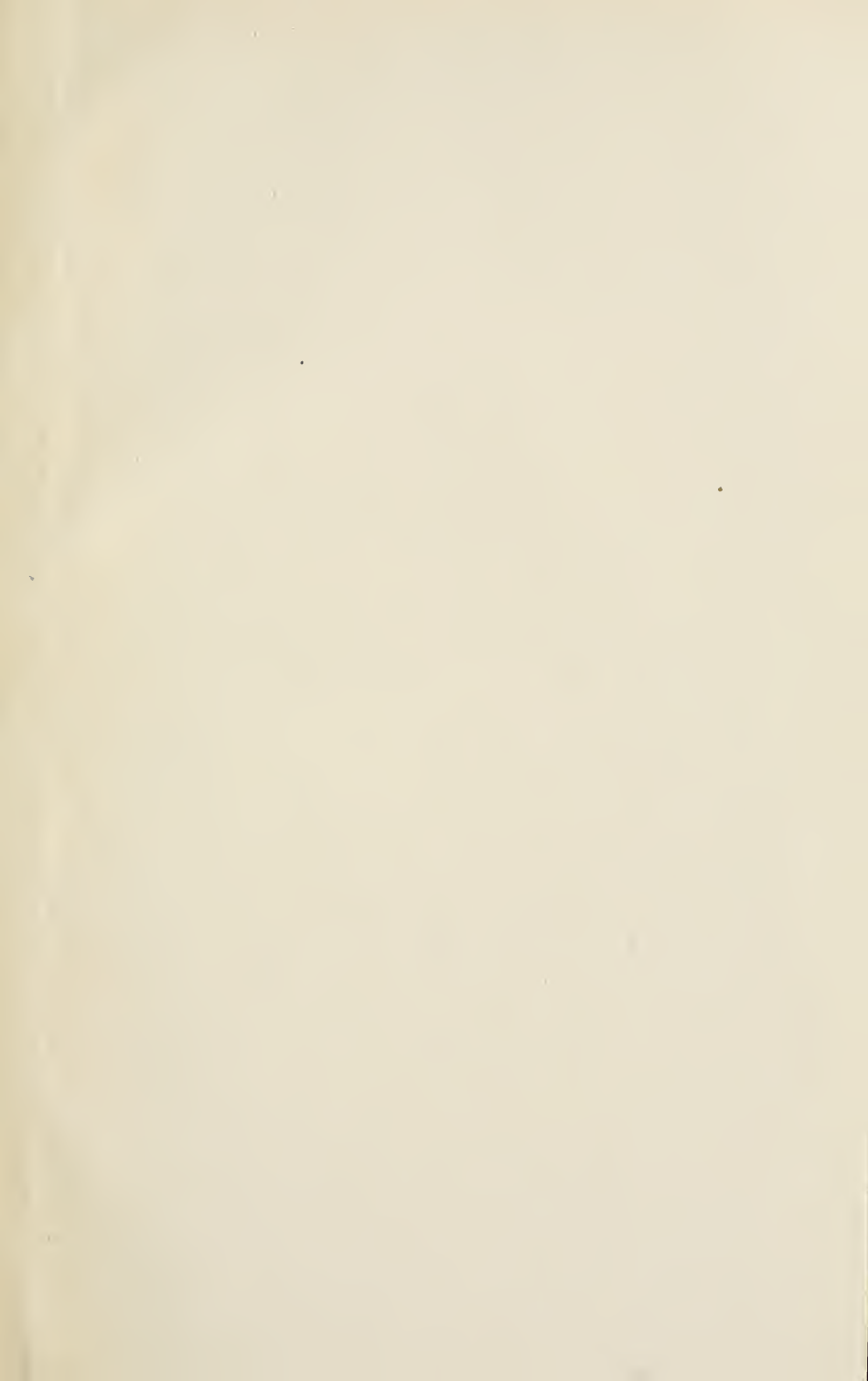
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